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AUTOMOTIVE DIESEL MAINTENANCE 2. UNIT XXII, MICHIGAN/CLARK TRANSMISSION--CONVERTER/TRANSMISSION.

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THIS MODULE OF A 25-MODULE COURSE IS DESIGNED TO DEVELOP A DETAILED UNDERSTANDING OF A SPECIFIC POWER CONVERTER AND TRANSMISSION USED ON DIESEL POWERED EQUIPMENT. TOPICS ARE A CLOSER LOOK AT THE CONVERTER, CONVERTER ASSEMBLY AND INSTALLATION, TRANSMISSION FUNCTION, AND TRANSMISSION SHIFTING. THE MODULE CONSISTS OF A SELF-INSTRUCTIONAL PROGRAMED TRAINING FILM "MICHIGAN/CLARK TRANSMISSION--TRANSMISSION AND CONVERTER FUNCTION" AND OTHER MATERIALS. SEE VT 005 685 FOR FURTHER INFORMATION. MODULES IN THIS SERIES ARE AVAILABLE AS VT 005 685 - VT 005 709. MODULES FOR "AUTOMOTIVE DIESEL MAINTENANCE 1" ARE AVAILABLE AS VT 005 655 - VT 005 684. THE 2-YEAR PROGRAM OUTLINE FOR "AUTOMOTIVE DIESEL MAINTENANCE 1 AND 2" IS AVAILABLE AS VT 006 006. THE TEXT MATERIAL, TRANSPARENCIES, PROGRAMED TRAINING FILM, AND THE ELECTRONIC TUTOR MAY BE RENTED (FOR $1.75 PER WEEK) OR PURCHASED FROM THE HUMAN ENGINEERING INSTITUTE, HEADQUARTERS AND DEVELOPMENT CENTER, 2341 CARNEGIE AVENUE, CLEVELAND, OHIO 44115. (HC)

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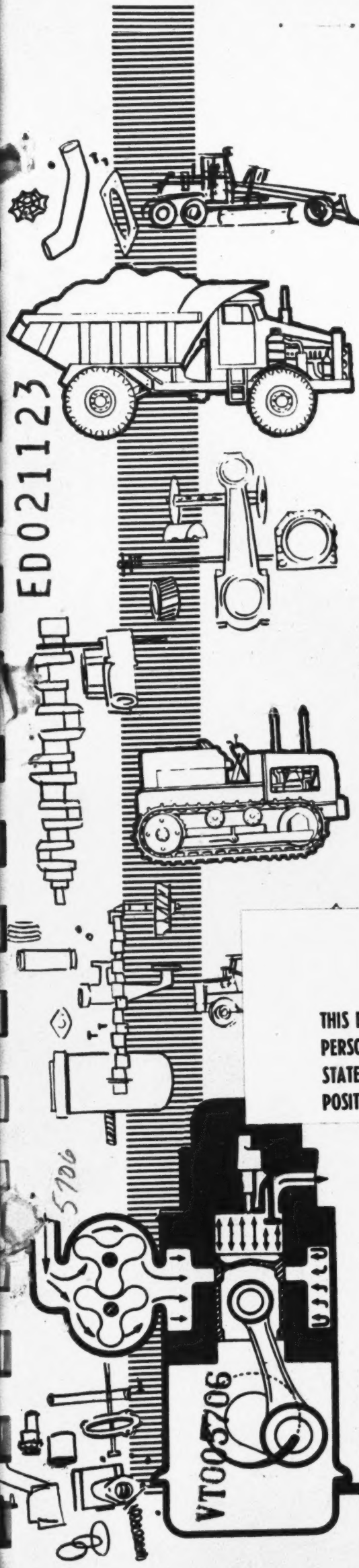

STUDY AND READING MATERIALS

AUTOMOTIVE DIESEL 2 MAINTENANCE

MICHIGAN/CLARK TRANSMISSION -- CONVERTER/TRANSMISSION

UNIT XXII

SECTION A — A CLOSER LOOK AT THE CONVERTER

SECTION B — CONVERTER ASSEMBLY AND INSTALLATION

SECTION C — TRANSMISSION FUNCTION

SECTION D — TRANSMISSION SHIFTING

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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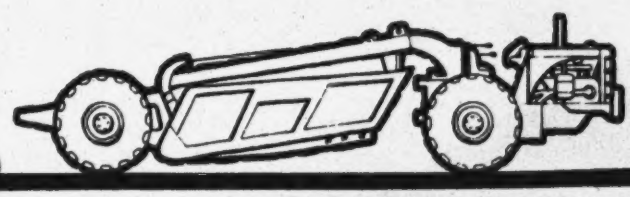


SECTION A -- A CLOSER LOOK AT THE CONVERTER

As we learned earlier, the converter portion of the power train performs an important role in delivering engine power to the driving wheels. The torque converter and the transmission function together and operate through a common hydraulic system. For serviceability, they have been designed and built as separate units.

NOTE: In our discussion of the Allison transmission we referred to the driving member portion of the converter as the pump. In the Michigan/ Clark converter this component is called the impeller.

CONVERTER FUNCTION -- The torque converter consists of four distinct members: the impeller, which is the driving member; the turbine, which is the driven member; the reaction member, which is splined on a fixed support; and the drive disc, which couples the converter to the engine. See Figure 1.

The impeller and drive disc members form the outer shell. The turbine runs within the outer shell and is connected to the output shaft. The oil is the only connection between the turbine and impeller members. The reaction member is splined to the converter support, which is fixed and does not rotate in either direction. A gear is splined to the impeller hub and drives through gears rotating the hydraulic pumps, mounted on the converter housing cover. Notice in Figure 1 which members rotate at engine speed, which member is stationary, and which member drives the transmission.

CONVERTER PRESSURE -- Pressure in the system is created by the clutch regulating valve spring (located in the transmission) and the converter regulating valve spring (located in the outlet side of the converter). See Figure 2. Also note that Figure 2 shows specifications on gearing adjustment and torque specifications on bolts.

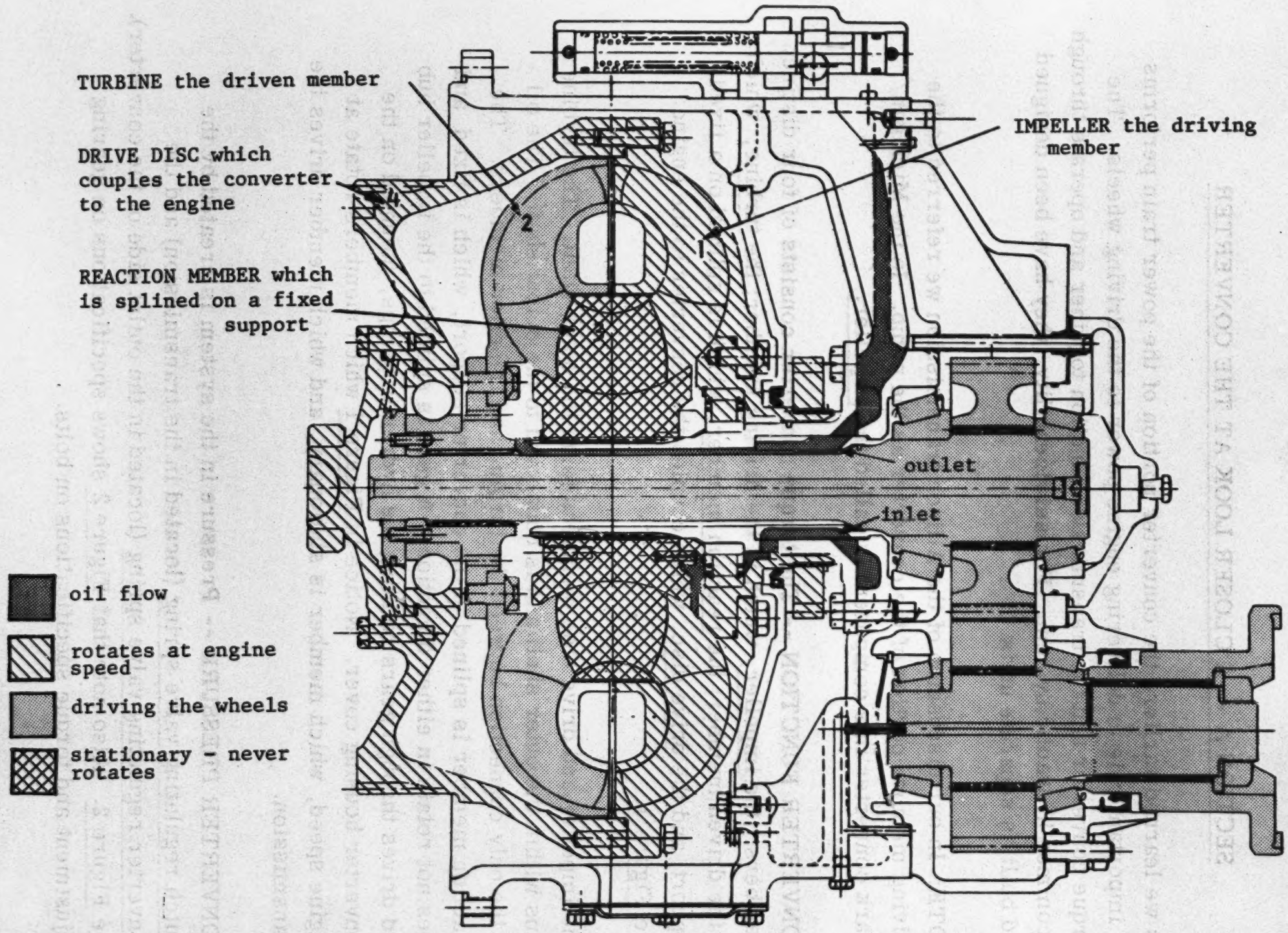

TURBINE the driven member
DRIVE DISC which couples the converter to the engine
REACTION MEMBER which is splined on a fixed support
IMPELLER the driving member
outlet
inlet
oil flow
rotates at engine speed
driving the wheels
stationary - never rotates

Fig. 1 8000 series converter

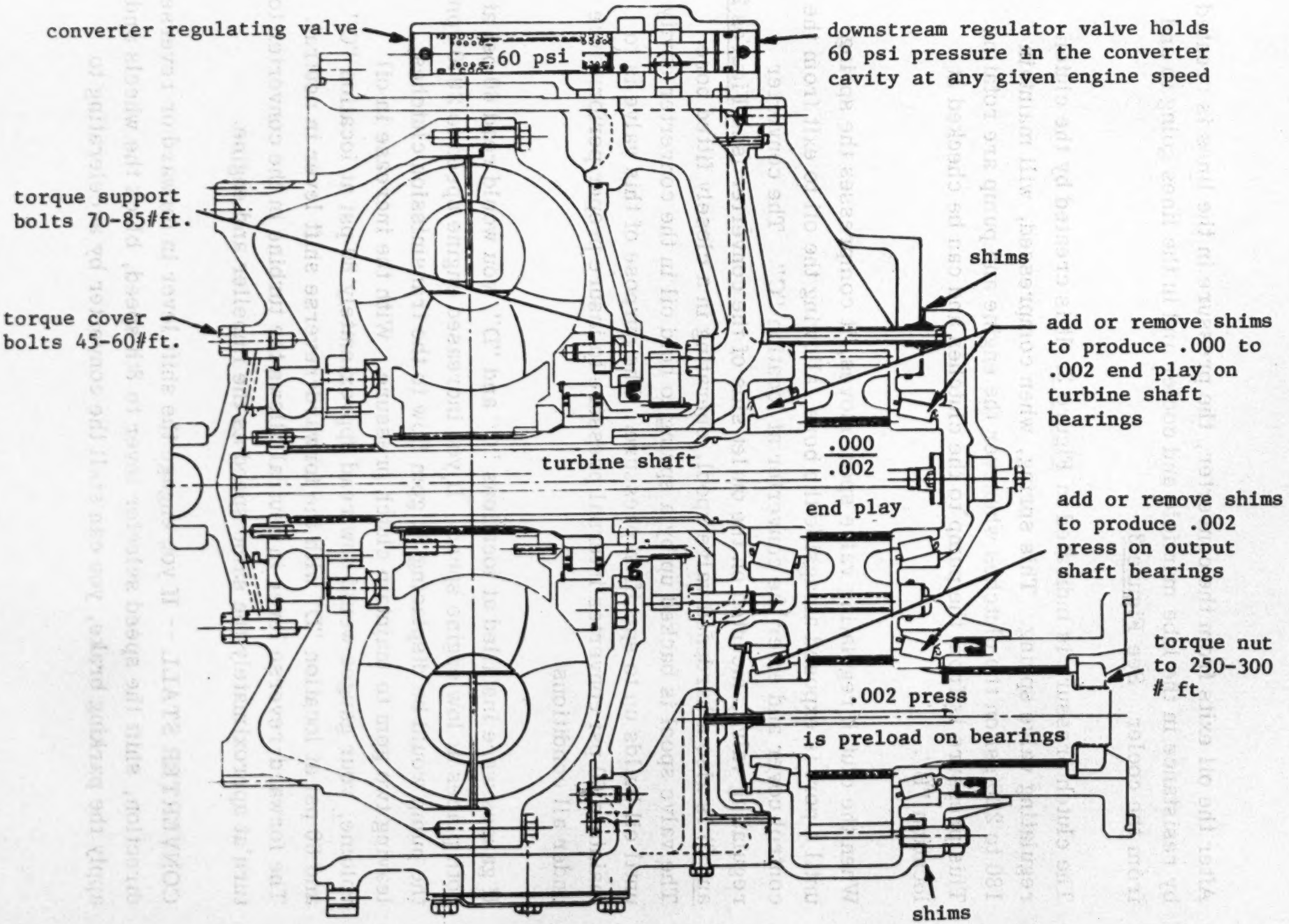

converter regulating valve
60 psi
downstream regulator valve holds 60 psi pressure in the converter cavity at any given engine speed
torque support bolts 70-85#ft.
torque cover bolts 45-60#ft.
shims
add or remove shims to produce .000 to .002 end play on turbine shaft bearings
turbine shaft
.000
.002
end play
add or remove shims to produce .002 press on output shaft bearings
torque nut to 250-300 # ft
.002 press
is preload on bearings
shims

Fig. 2 Torque and shim specifications

After the oil exits from the converter, the pressure in the lines is created by resistance in the lube manifold and cooler and in the lines going to and from the cooler. See Figure 3.

The clutch pressure is indicated in Figure 3. It is created by the clutch regulating valve spring. This spring, when compressed, will maintain 180 to 220 psi on the clutches whenever the engine and pump are rotating. This pressure is from the pump to the clutches and can be checked at location "B".

When the clutch regulating valve spool moves, it compresses the spring until a port is exposed alongside the bore, allowing the oil to exit from the control cover and enter the converter at location "C". The converter regulating valve, mounted on the outlet side of the converter (see Figures 2 and 3) is also a hardened valve spool, operating in a closely fitted bore. The valve spool is backed up by a spring to hold oil in the converter cavity until oil builds up to specified pressure. The purpose of this valve is to maintain 60 psi converter internal pressure to insure proper performance under all conditions.

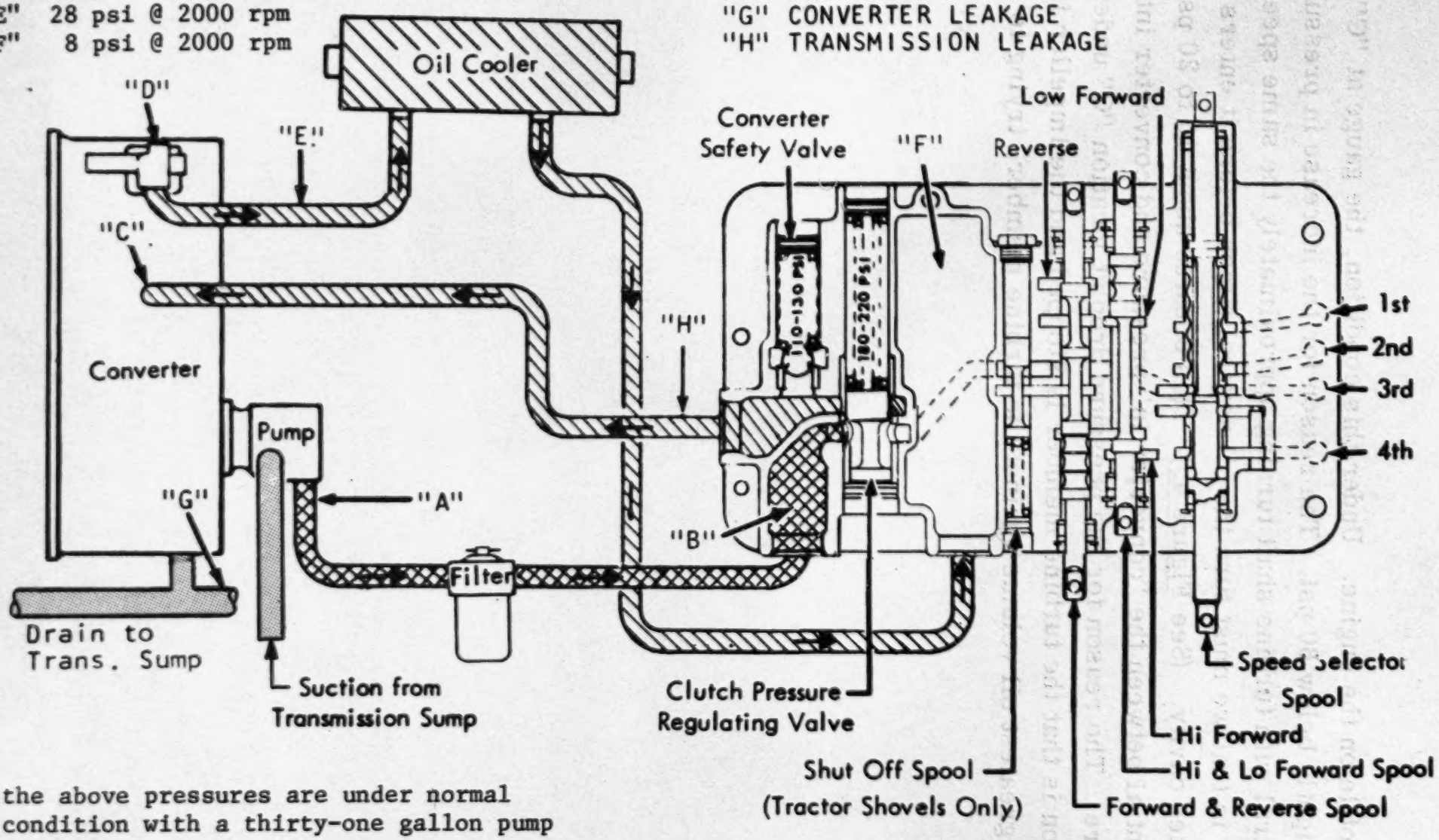
If gauges were installed at locations "C" and "D", you would read 60 psi at both places at low engine speed. If you increased engine speed to 2000 rpm, the pump would be displacing 31 gpm flow to the transmission clutches, leaving two gpm to maintain clutch pressure. With the increase in oil volume, your gauges would now read approximately 80 psi at location "C" and 60 psi at location "D" with the forward-reverse shift lever in neutral. The forward-reverse lever in neutral allows the turbine in the converter to turn at approximately the same speed as the impeller and engine.

CONVERTER STALL -- If you engage the shift lever in forward or reverse direction, shift the speed selector lever to 8th speed, block the wheels and apply the parking brake, you can stall the converter by accelerating to

ALL PRESSURE CHECKS MADE WITH HOT OIL

"B" 180 psi to 220 psi @ low engine idle
"C" 80 psi @ 2000 rpm trans. in neutral
40 psi @ 2000 rpm stall.
"D" 60 psi @ high and low engine idle
"E" 28 psi @ 2000 rpm
"F" 8 psi @ 2000 rpm

"A" PUMP OUT PUT
"B" CLUTCH PRESSURE
"C" CONVERTER IN PRESSURE
"D" CONVERTER INTERNAL PRESSURE
"E" COOLER IN PRESSURE
"F" LUB PRESSURE
"G" CONVERTER LEAKAGE
"H" TRANSMISSION LEAKAGE

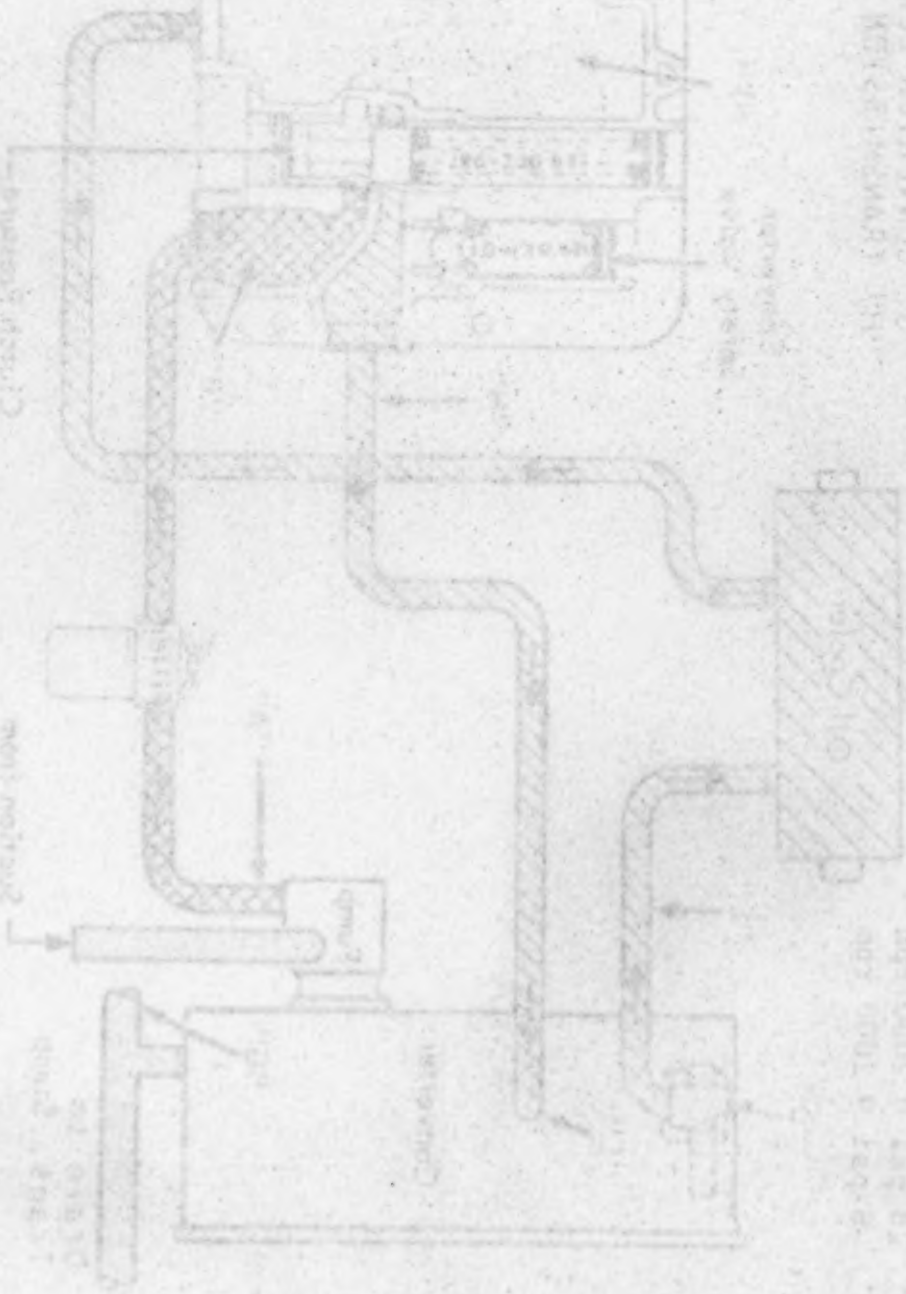


- the above pressures are under normal condition with a thirty-one gallon pump
- all pressures are taken at 2000 rpm except clutch pressure; clutch pressure is taken at low engine idle

180-220 psi 5-90 psi no pressure

Fig. 3 Transmission control internal oil flow

full throttle on the engine. Under this condition, the gauge at "C" would drop slightly below 60 psi. The reason for the increase in pressure at "C" (in neutral with turbine shaft turning approximately the same speed as the engine) is that we must turn the oil several times before it enters the converter cavity. (See Figure 4.) This creates about 10 to 20 psi differential between the "converter in" pressure and converter internal pressure. The reason for the pressure drop at location "C" under stall condition is that the turbine member is stopped and the impeller is pumping its greatest oil volume against the turbine member, trying to make it turn.



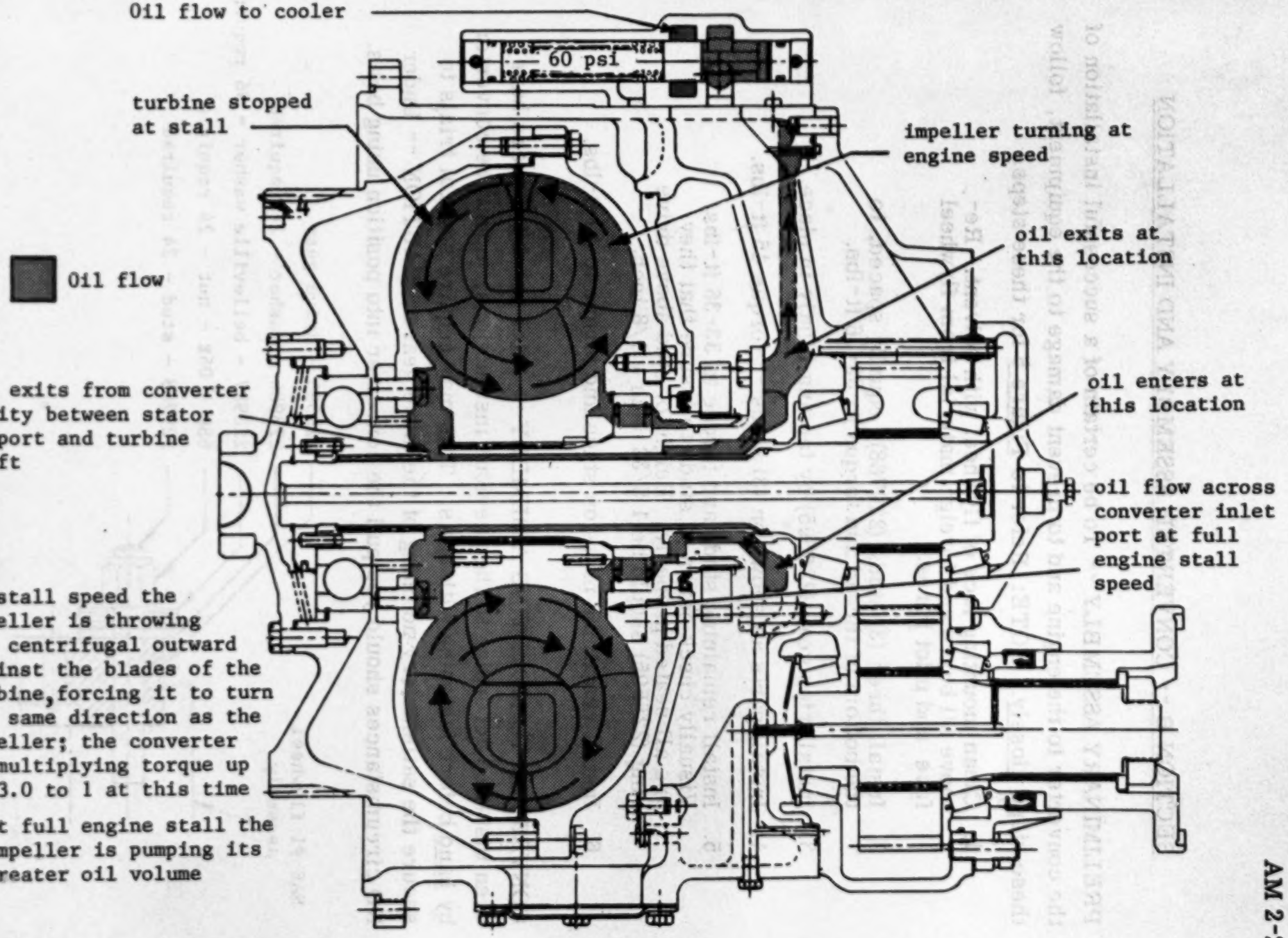

Oil flow to cooler
60 psi
turbine stopped at stall
impeller turning at engine speed
Oil flow
oil exits at this location
oil exits from converter cavity between stator support and turbine shaft
oil enters at this location
oil flow across converter inlet port at full engine stall speed
at stall speed the impeller is throwing oil centrifugal outward against the blades of the turbine, forcing it to turn the same direction as the impeller; the converter is multiplying torque up to 3.0 to 1 at this time
at full engine stall the impeller is pumping its greater oil volume

Fig. 4 Oil flow in the converter

SECTION B -- CONVERTER ASSEMBLY AND INSTALLATION

PRELIMINARY ASSEMBLY -- To be certain of a successful installation of the converter to the engine and to prevent damage to the equipment, follow these steps closely. NOTE: Refer to Figure 5 for these steps.

1. Clean mounting face of flywheel with solvent. Remove all burrs and foreign material from flywheel face and pilot bores.
2. Install three (3) studs (229768), equally spaced, to the bottom of thread and torque to 33-36 ft-lbs.
3. Install ring gear (226595) by tapping lightly in place.
4. Install parts as shown on (3) studs -- torque 45 ft-lbs.
5. Install remaining studs and torque to 33-36 ft-lbs. Visually check height of studs to insure that they are all seated properly. Height of stud above drive ring (226595) should be 1 5/32 inch ± 1/8 inch.
6. Install remaining parts on studs and torque to 45 ft-lbs.

CONVERTER TO MOUNTING ASSEMBLY -- After the drive gears have been installed according to the previous instructions, mount the converter by hand before fastening with bolts. This may require several trials to secure the satisfactory notching of the drive gears. CAUTION -- Under NO circumstances should you pull the converter into position using bolts.

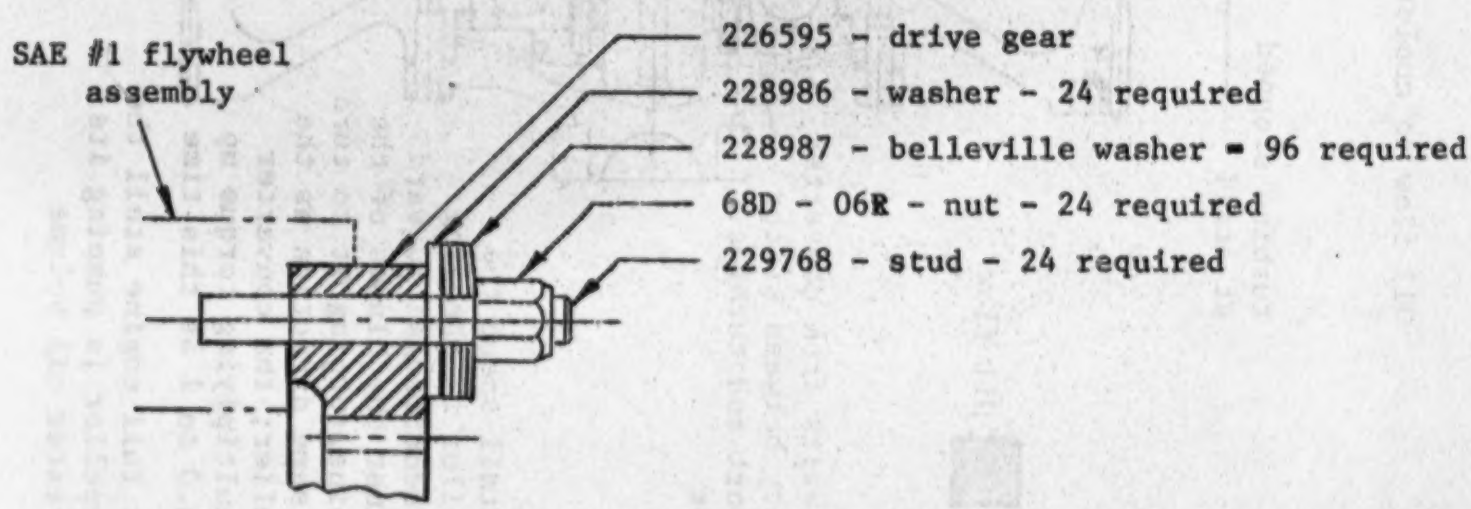

SAE #1 flywheel assembly
226595 - drive gear
228986 - washer - 24 required
228987 - belleville washer - 96 required
68D - 06R - nut - 24 required
229768 - stud - 24 required

Fig. 5 Drive gear to flywheel installation

All drive gears must be slipped on the converter driven gear to check for proper fit. Tight drive gears can result in engine failure if the converter has not been installed correctly.

The converter pilot and flywheel bore must be checked for proper clearance whenever the converter is separated from the engine for overhaul or repairs.

The converter pilot fits into the engine flywheel bore with a .003 maximum clearance. The converter pilot must be a slip fit into the engine flywheel bore -- .001 is minimum clearance.

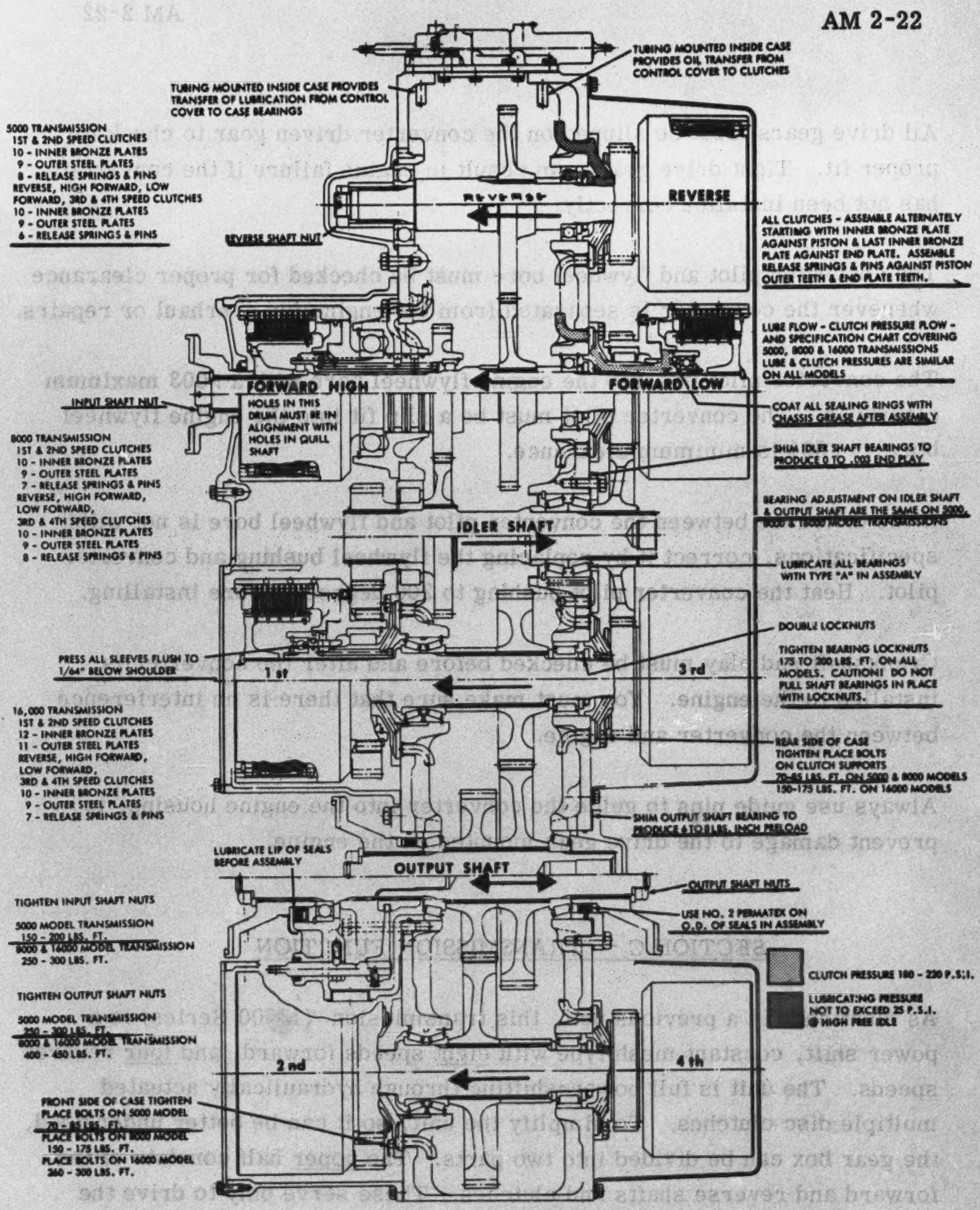
If the tolerance between the converter pilot and flywheel bore is not within specifications, correct it by replacing the flywheel bushing and converter pilot. Heat the converter pilot bushing to 200 degrees before installing.

Crankshaft end play must be checked before and after the converter is installed to the engine. You must make sure that there is no interference between the converter and engine.

Always use guide pins to guide the converter into the engine housing, to prevent damage to the drive gear mounted on the engine.

SECTION C -- TRANSMISSION FUNCTION

As mentioned in a previous unit, this transmission (16000 Series) is a power shift, constant mesh type with eight speeds forward, and four reverse speeds. The unit is full power-shifting through hydraulically actuated multiple disc clutches. To simplify the unit, so it can be better understood, the gear box can be divided into two parts. The upper half consists of the forward and reverse shafts and clutches. These serve only to drive the idler shaft in the desired direction. See Figure 6.


TUBING MOUNTED INSIDE CASE PROVIDES OIL TRANSFER FROM CONTROL COVER TO CLUTCHES
TUBING MOUNTED INSIDE CASE PROVIDES TRANSFER OF LUBRICATION FROM CONTROL COVER TO CASE BEARINGS
5000 TRANSMISSION
1ST & 2ND SPEED CLUTCHES
10 - INNER BRONZE PLATES
9 - OUTER STEEL PLATES
8 - RELEASE SPRINGS & PINS
REVERSE, HIGH FORWARD, LOW FORWARD, 3RD & 4TH SPEED CLUTCHES
10 - INNER BRONZE PLATES
9 - OUTER STEEL PLATES
6 - RELEASE SPRINGS & PINS
REVERSE SHAFT NUT
REVERSE
ALL CLUTCHES - ASSEMBLE ALTERNATELY STARTING WITH INNER BRONZE PLATE AGAINST PISTON & LAST INNER BRONZE PLATE AGAINST END PLATE. ASSEMBLE RELEASE SPRINGS & PINS AGAINST PISTON OUTER TEETH & END PLATE TEETH.
LUBE FLOW - CLUTCH PRESSURE FLOW - AND SPECIFICATION CHART COVERING 5000, 8000 & 16000 TRANSMISSIONS LUBE & CLUTCH PRESSURES ARE SIMILAR ON ALL MODELS
FORWARD HIGH
FORWARD LOW
INPUT SHAFT NUT
HOLES IN THIS DRUM MUST BE IN ALIGNMENT WITH HOLES IN QUILL SHAFT
COAT ALL SEALING RINGS WITH CHASSIS GREASE AFTER ASSEMBLY
8000 TRANSMISSION
1ST & 2ND SPEED CLUTCHES
10 - INNER BRONZE PLATES
9 - OUTER STEEL PLATES
7 - RELEASE SPRINGS & PINS
REVERSE, HIGH FORWARD, LOW FORWARD,
3RD & 4TH SPEED CLUTCHES
10 - INNER BRONZE PLATES
9 - OUTER STEEL PLATES
8 - RELEASE SPRINGS & PINS
SHIM IDLER SHAFT BEARINGS TO PRODUCE 0 TO .003 END PLAY
BEARING ADJUSTMENT ON IDLER SHAFT & OUTPUT SHAFT ARE THE SAME ON 5000, 8000 & 16000 MODEL TRANSMISSIONS
IDLER SHAFT
LUBRICATE ALL BEARINGS WITH TYPE "A" IN ASSEMBLY
DOUBLE LOCKNUTS
TIGHTEN BEARING LOCKNUTS 175 TO 200 LBS. FT. ON ALL MODELS. CAUTION! DO NOT PULL SHAFT BEARINGS IN PLACE WITH LOCKNUTS.
PRESS ALL SLEEVES FLUSH TO 1/64" BELOW SHOULDER
1 st
3 rd
16,000 TRANSMISSION
1ST & 2ND SPEED CLUTCHES
12 - INNER BRONZE PLATES
11 - OUTER STEEL PLATES
REVERSE, HIGH FORWARD, LOW FORWARD,
3RD & 4TH SPEED CLUTCHES
10 - INNER BRONZE PLATES
9 - OUTER STEEL PLATES
7 - RELEASE SPRINGS & PINS
REAR SIDE OF CASE TIGHTEN PLACE BOLTS ON CLUTCH SUPPORTS
70-85 LBS. FT. ON 5000 & 8000 MODELS
150-175 LBS. FT. ON 16000 MODELS
SHIM OUTPUT SHAFT BEARING TO PRODUCE 6 TO 8 LBS. INCH PRELOAD
LUBRICATE LIP OF SEALS BEFORE ASSEMBLY
OUTPUT SHAFT
OUTPUT SHAFT NUTS
USE NO. 2 PERMATEX ON O.D. OF SEALS IN ASSEMBLY
TIGHTEN INPUT SHAFT NUTS
5000 MODEL TRANSMISSION
150 - 200 LBS. FT.
8000 & 16000 MODEL TRANSMISSION
250 - 300 LBS. FT.
CLUTCH PRESSURE 180 - 220 P.S.I.
LUBRICATING PRESSURE NOT TO EXCEED 25 P.S.I. @ HIGH FREE IDLE
TIGHTEN OUTPUT SHAFT NUTS
5000 MODEL TRANSMISSION
250 - 300 LBS. FT.
8000 & 16000 MODEL TRANSMISSION
400 - 450 LBS. FT.
2 nd
4 th
FRONT SIDE OF CASE TIGHTEN
PLACE BOLTS ON 5000 MODEL
70 - 85 LBS. FT.
PLACE BOLTS ON 8000 MODEL
150 - 175 LBS. FT.
PLACE BOLTS ON 16000 MODEL
240 - 300 LBS. FT.

all shafts must be removed in the direction of the arrows, block all gears in their position before removing shafts

Fig. 6 Transmission cutaway

The lower half is the speed section and receives power from both ends of the idler shaft. If the first and second clutches are applied, power is transmitted from the idler pinion gear (on the forward end of the idler shaft) to the large gear on the clutch drum. From there, it passes through the clutch to the shaft, and through the final gears to the output. The ratio between first and second is obtained by the differences in the final output drive ratios.

Third and fourth gears are similarly obtained except that their respective clutches are driven by the large gear on the rear end of the idler shaft. The drive to the output shaft is through the same gears as for the first and second speeds.

NOTE: There must be two clutches engaged before the vehicle can be put in motion. In this respect it is similar to the Allison transmission.

The direction (speed) clutch assembly consists of a drum with internal gear teeth and a bore to receive a hydraulically actuated piston. The piston is inserted into the bore of the drum. The piston is made "oil tight" through the use of sealing rings. A bronze disc with internal teeth is inserted into the drum and rests against the piston. Next, a disc with splines at the outer diameter is inserted. Discs are alternated until the required total is achieved. After inserting the last disc, a series of springs and pins are assembled in such a manner that these springs rest on teeth of the piston. A heavy backup plate is then inserted and secured by a snap ring. A hub, with ID and OD splines is inserted into the splines of a disc with teeth on the inner diameter, and with a splined shaft extending through the clutch support. This hub is retained by a snap ring. The disc and inner shaft are free to increase in speed or rotate in the opposite direction as long as no pressure is present in the direction (speed) clutch.

To engage the clutch, the control valve is placed in the desired position. This allows oil under pressure to flow from the control cover valve, through

a tube in the transmission case, to a chosen clutch. Once into the drum, oil is directed through a drilled hole into the rear side of the piston bore. The pressure of the oil forces the piston and disc over against the heavy backup plate. This disc, with teeth on the outer diameter clamping against discs with teeth on the inner diameter, enables the clutch drum and drive shaft to be locked together and allows them to turn as a unit.

TRAVEL SPEED RANGES -- The following represents a listing of the vehicle speeds that can be obtained in the various ranges.

	1st	2nd	3rd	4th	5th	6th	7th	8th
Forward mph	0-3.8	0-5.1	0-6.9	0-9.1	0-12,2	0-16.0	0-21.8	0-28.8
Reverse mph	0-3.8	---	0-6.9	---	0-12.2	---	0-21.8	

CLUTCH ENGAGEMENT -- The following chart shows the different clutches which are engaged while in 1st through 8th gear (both <u>forward</u> and <u>reverse</u>).

<u>FORWARD SPEEDS</u>

1st gear	Forward low and 1st speed clutch
2nd gear	Forward high and 1st speed clutch
3rd gear	Forward low and 2nd speed clutch
4th gear	Forward high and 2nd speed clutch
5th gear	Forward low and 3rd speed clutch
6th gear	Forward high and 3rd speed clutch
7th gear	Forward low and 4th speed clutch
8th gear	Forward high and 4th speed clutch

<u>REVERSE SPEEDS</u>

1st gear	Reverse and 1st speed clutch
2nd gear	Same as 1st gear on shift levers
3rd gear	Reverse and 2nd speed clutch
4th gear	Same as 3rd gear
5th gear	Reverse and 3rd speed clutch
6th gear	Same as 5th gear
7th gear	Reverse and 4th speed clutch
8th gear	Same as 7th gear

ADJUSTMENTS AND ASSEMBLY INSTRUCTIONS -- Notice in Figure 6 that all adjustments and assembly instructions are shown. This figure covers the 5000, 8000 and 16000 series transmission assemblies. This is possible because of the similar designs and interchangeable features.

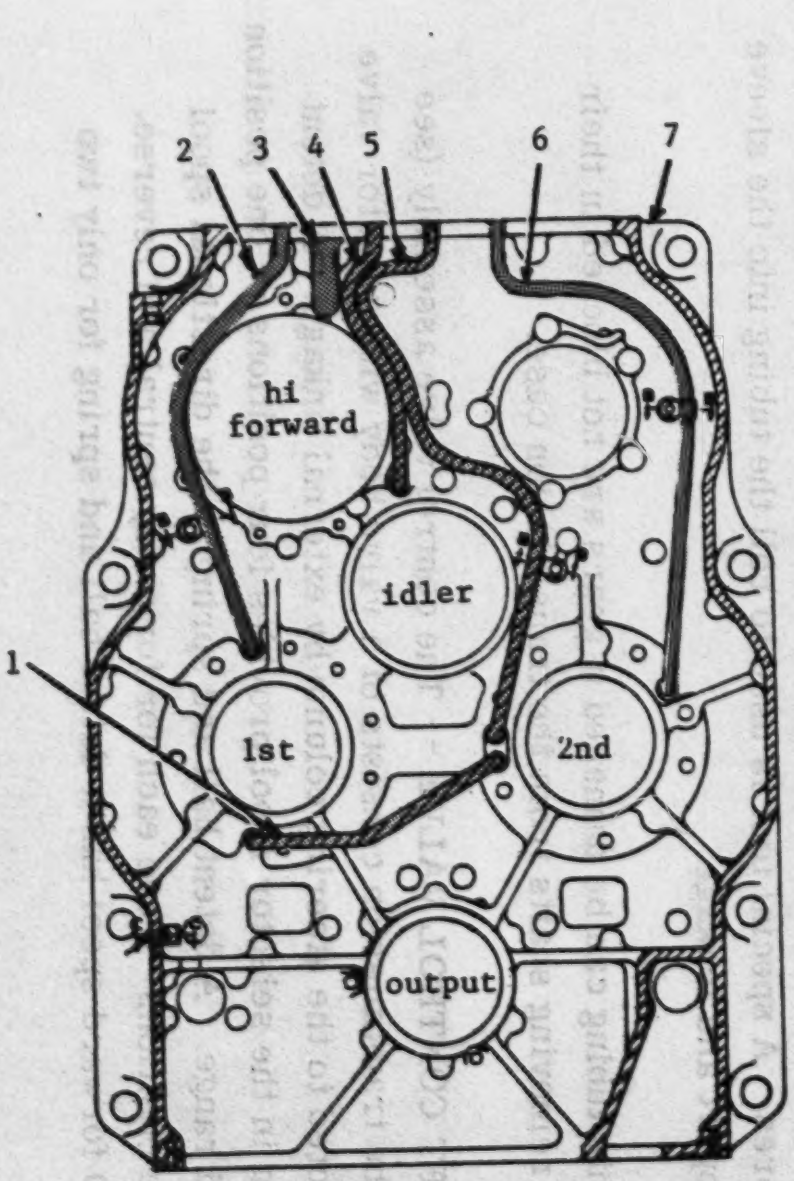
There are two adjustments that must be made in re-assembly of the transmission. One is to shim the idler shaft bearings to produce 0 to 0. 003 end play. The second is to shim the output shaft bearings to produce 6 to 8 lb. -in. preload.
NOTE: It is very important to tighten bolts and shaft nuts to specifications. Also, there are replaceable sleeves in all clutch drums. These must be replaced according to specifications.

INTERNAL TUBING DIAGRAM -- Figure 7 shows the tubing mounted inside the transmission which directs oil to the clutches and also to all bearings. Lines show flow to the bearings and clutch disc, as well as the oil pressure flow to the clutches.

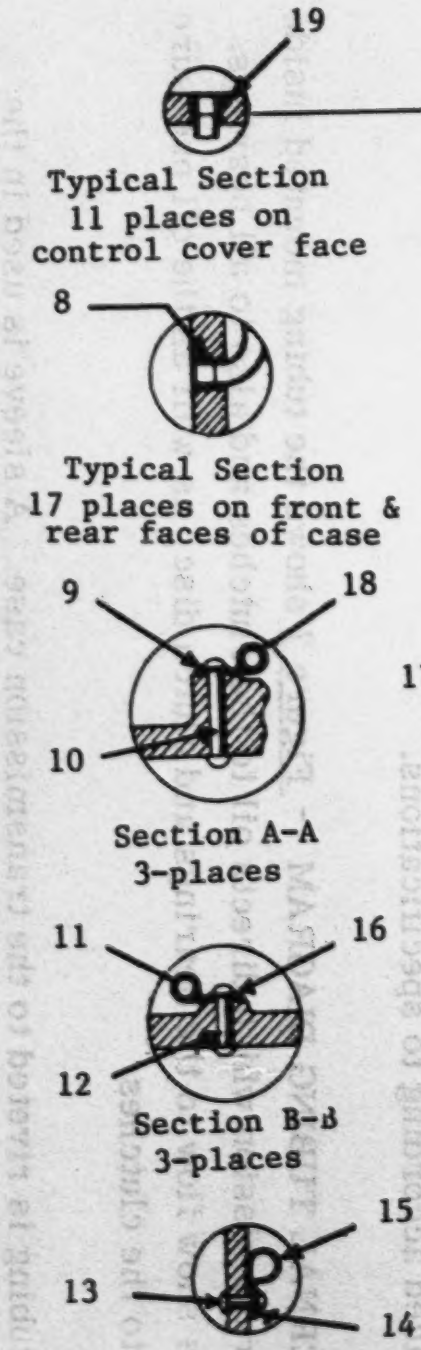
The tubing is riveted to the transmission case. A sleeve is used in the case tubing bores. A special tool is used to roll the tubing into the sleeve for proper support and leakage.

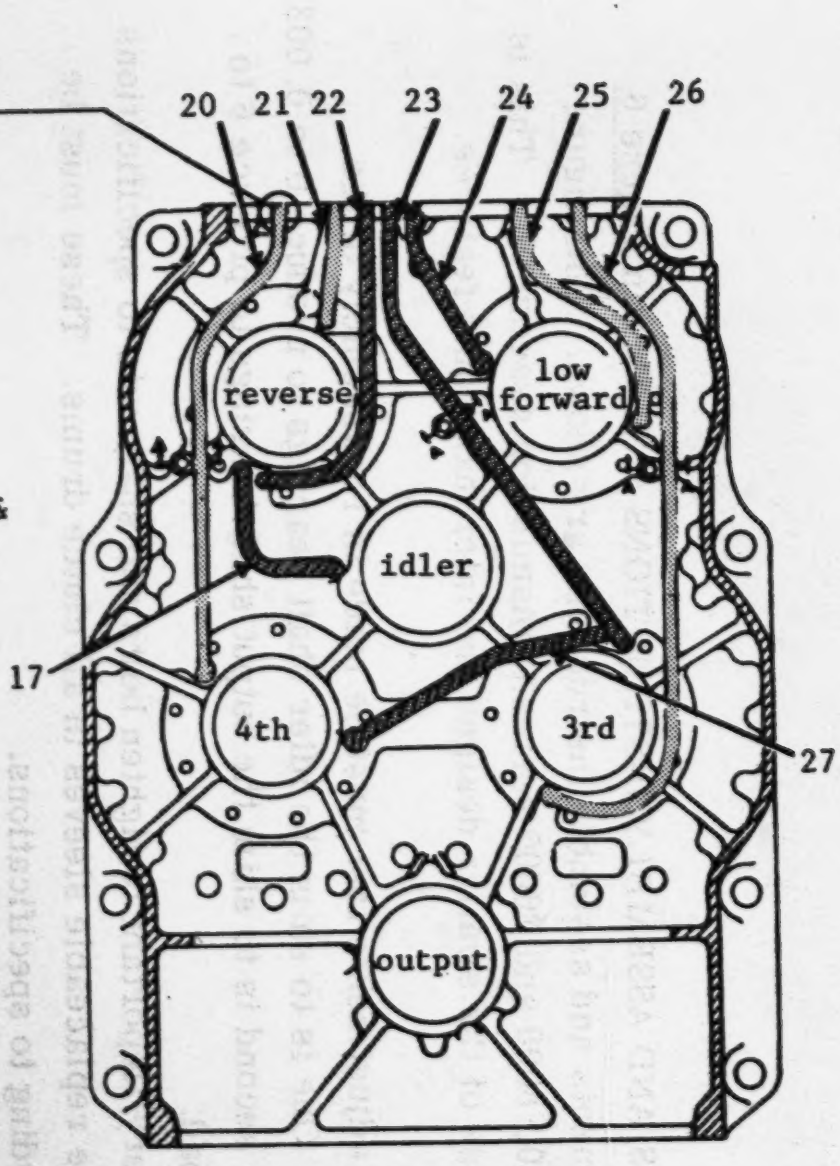
CAUTION: This tubing can be damaged if gears are not blocked in their position when removing shafts from the transmission case.

MANUAL SHIFT CONTROL VALVE -- The control valve assembly (see Figure 8) on the transmission consists of a valve body with selector valve spools, connected to the steering column by external linkage. A detent ball and spring in the selector spool provides four positions -- one position for each speed range. A detent ball and spring in the directional spool provides three positions -- one each for forward, neutral and reverse. The HI and LO forward spool has a detent ball and spring for only two



front-inside
engine side of case





rear-inside
opposite engine
side of case

clutch pressure
shows flow to the clutches

lube pressure
shows flow to the bearings
and clutch disc

Fig. 7 Internal tubing diagram

manual shift spools & oil flow in & out of control valve

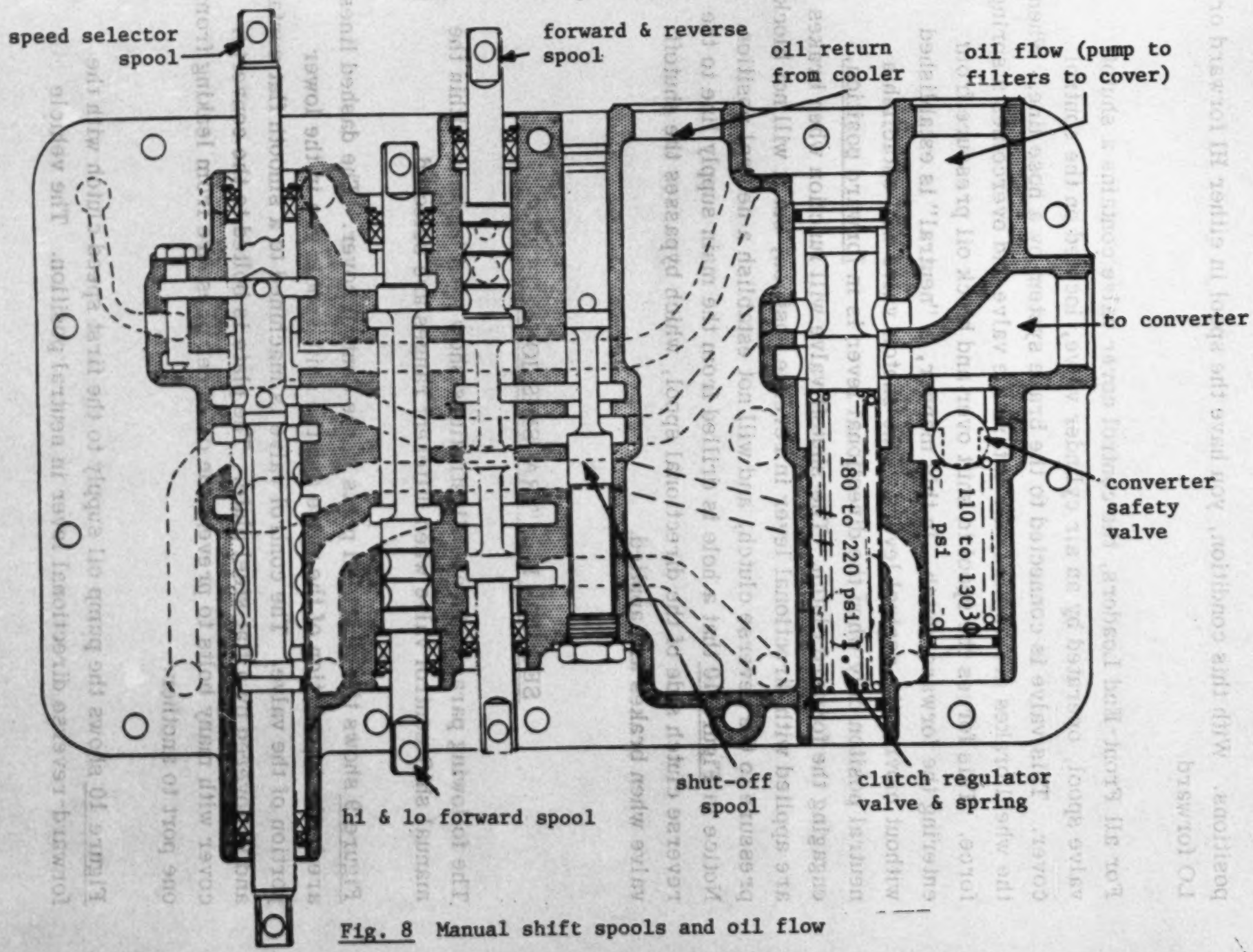


Fig. 8 Manual shift spools and oil flow

positions. With this condition, you have the spool in either HI forward or LO forward.

For all Front-End Loaders, the control cover valve contains a shutoff valve spool, operated by an air cylinder valve, located on the control cover. This valve is connected to the brake system by a hose line. When the wheel brakes are applied, air enters the valve and overcomes a spring force. This forces the spool to shift over and block oil pressure from entering the forward clutch. In this manner, a "neutral" is established without moving the control levers. The shutoff valve will establish a neutral positon only when the directional lever is in forward position, engaging the forward clutch. The shutoff valve will function when brakes are applied with directional lever in reverse position, but it will not block pressure to the reverse clutch, and will not establish a neutral position. Notice in Figure 10 that a hole is drilled from the main supply line to the reverse clutch side of the directional spool, which bypasses the shutoff valve when brakes are applied.

SECTION D -- TRANSMISSION SHIFTING

The following paragraphs and illustrations show what happens within the manual shift control valve when different ranges are selected.

Figure 9 shows the clutch oil ports in the control cover. The dashed lines are in the top portion of the valve and the shift spools are in the lower portion of the valve. The control valve is machined to a smooth flat surface and is covered by a flat steel plate. The plate is bolted to the converter cover with many bolts to prevent the oil under pressure from leaking from one port to another.

Figure 10 shows the pump oil supply to the first speed clutch with the forward-reverse directional lever in neutral position. The vehicle will

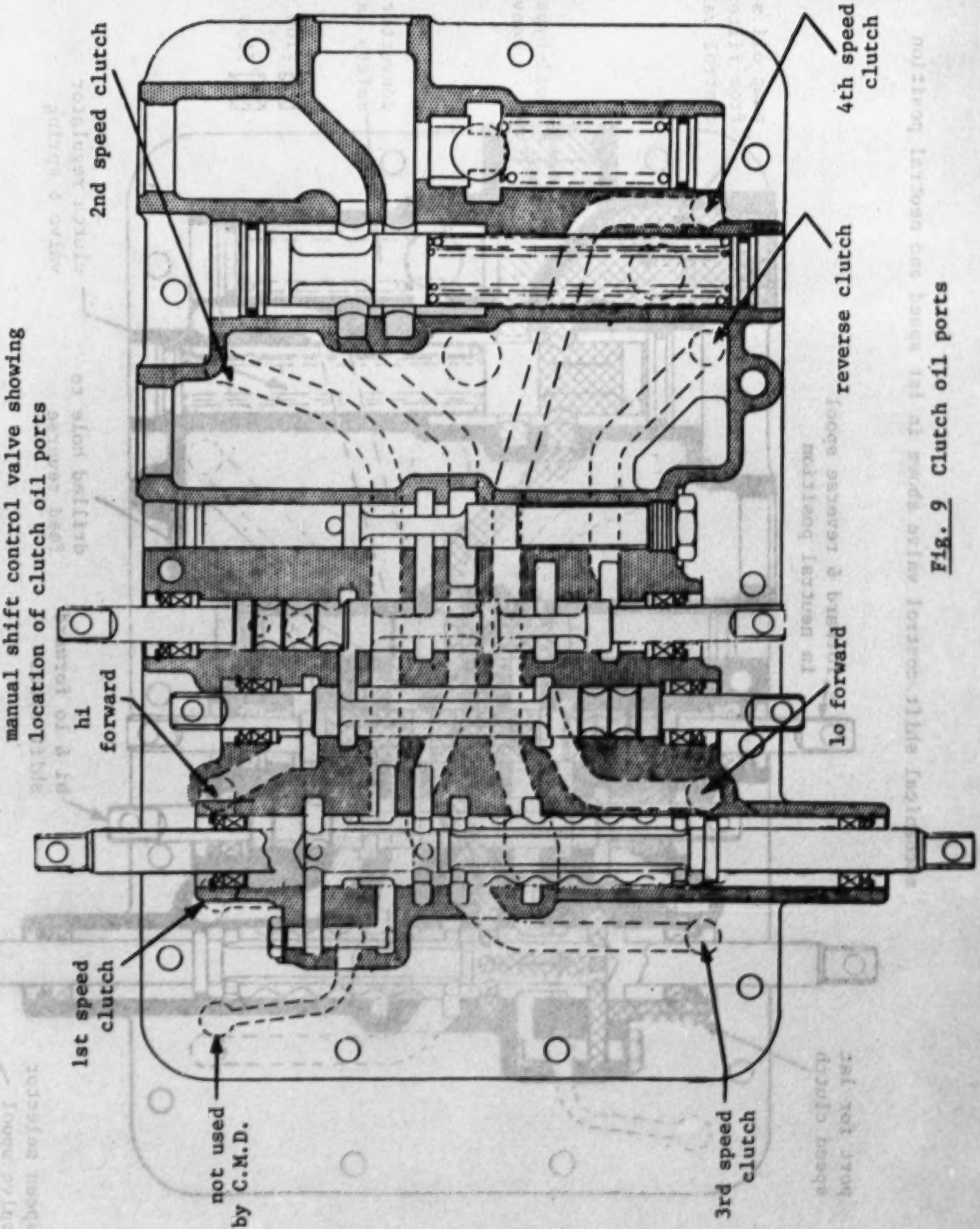


Fig. 9 Clutch oil ports

mechanical shift control valve shown in 1st speed and neutral position

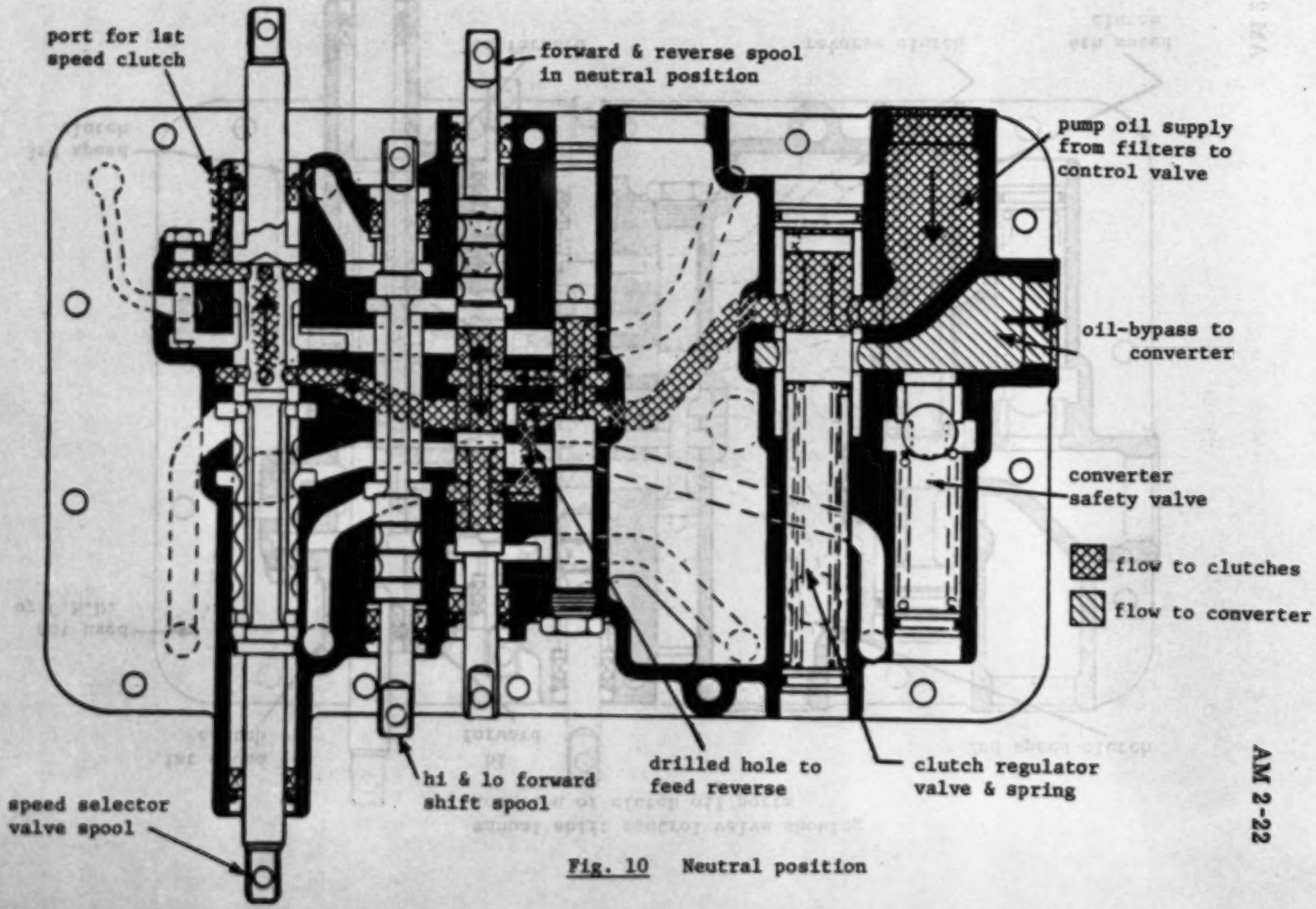

port for 1st speed clutch
forward & reverse spool in neutral position
pump oil supply from filters to control valve
oil-bypass to converter
converter safety valve
flow to clutches
flow to converter
speed selector valve spool
hi & lo forward shift spool
drilled hole to feed reverse
clutch regulator valve & spring

Fig. 10 Neutral position

will not move with the valve in this position because the 1st speed clutch is the only clutch engaged.

Figure 11 shows the oil pump supply to 1st speed clutch and LO forward clutch. The vehicle will now move in 1st gear with valve in this position. The speed is 0-3. 8 mph. If the HI and LO forward spool were shifted upward, you can see that the HI forward clutch would be engaged. This would give a 2nd gear 0-5. 1 mph situation.

Figure 12 shows the pump oil supply to 2nd speed clutch and LO forward clutch. Now the vehicle is in 3rd gear. The speed now is 0-6. 9 mph. Shifting the HI and LO forward spool to the upward position gives you 4th gear and speeds up to 0-9. 1 mph.

Figure 13 shows the pump oil supply to 3rd speed clutch and LO forward clutch. The control valve now shows the vehicle in 5th gear, traveling 0-12. 2 mph. If HI and LO forward spool were shifted upwards, then the 3rd clutch and HI forward clutch would be engaged. The vehicle would then be in 6th gear, traveling 0-16. 0 mph.

Figure 14 shows the oil supply to 4th speed clutch and LO forward clutch. The vehicle would now be operating in 7th gear traveling 0-21. 8 mph. Again, if a shift of the HI and LO forward spool were made upward, the vehicle would be in 8th gear, traveling 0-28. 8 mph.

Always remember that on the speed selector spool, oil flows through the spool to 1st speed and 4th speed clutches, then around the spool for 2nd and 3rd speed clutches.

There are four clutches on the speed selector lever and two forward clutches. This gives a total of eight speeds forward.

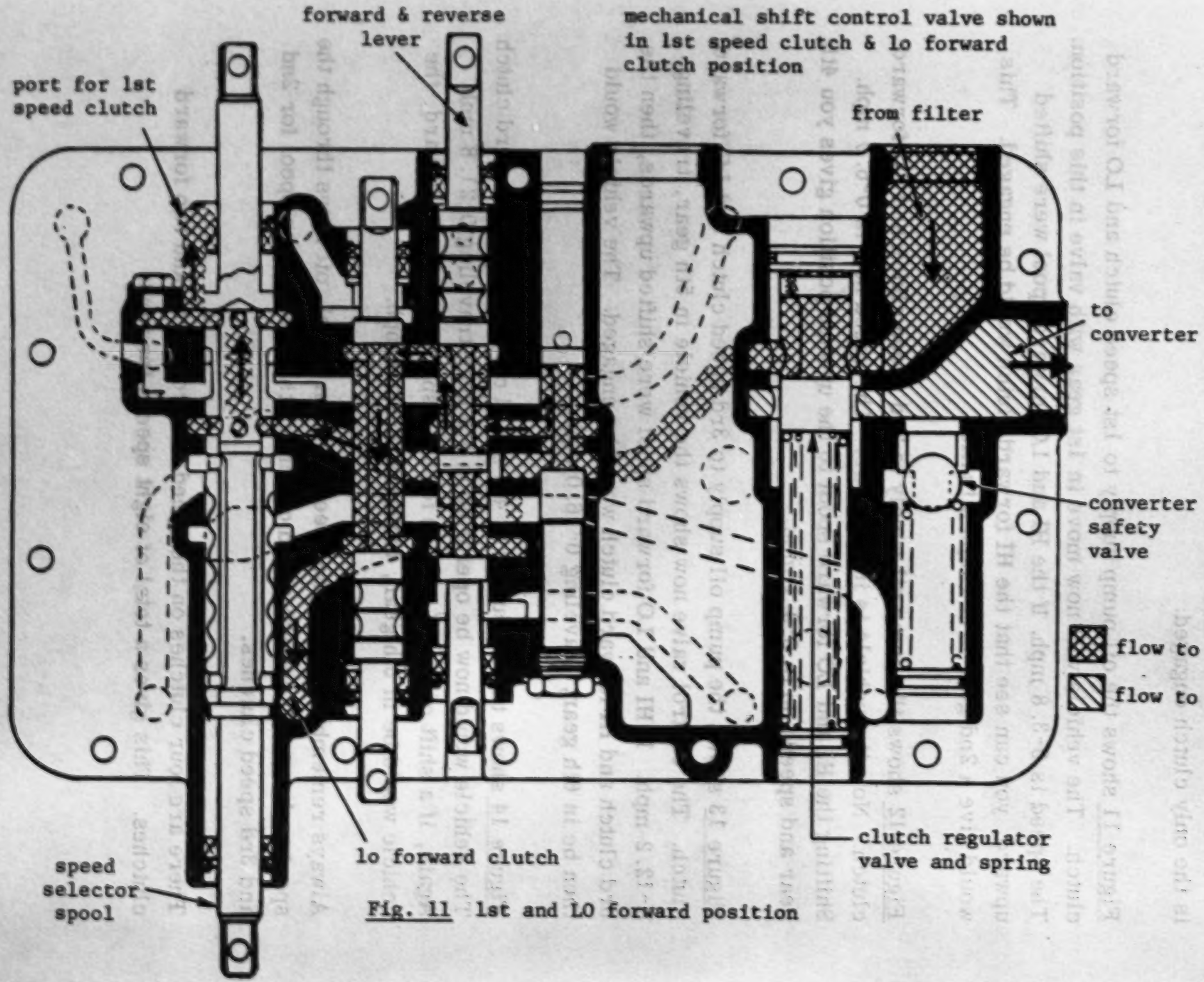

forward & reverse lever
mechanical shift control valve shown in 1st speed clutch & lo forward clutch position
port for 1st speed clutch
from filter
to converter
converter safety valve
flow to clutches
flow to converter
speed selector spool
lo forward clutch
clutch regulator valve and spring

Fig. 11 1st and LO forward position

mechanical shift control valve shown in 2nd speed clutch & lo forward clutch position

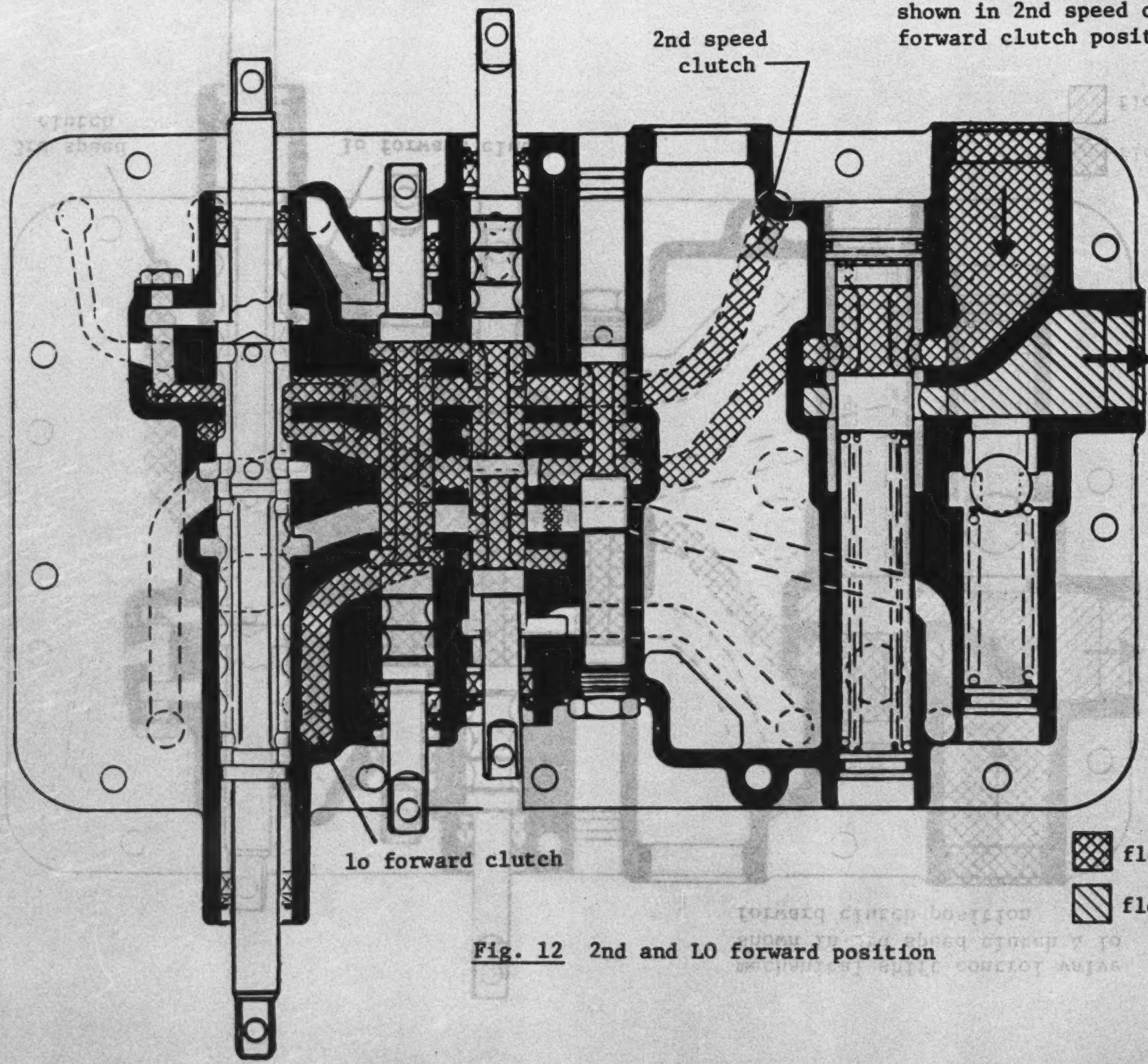


Fig. 12 2nd and LO forward position

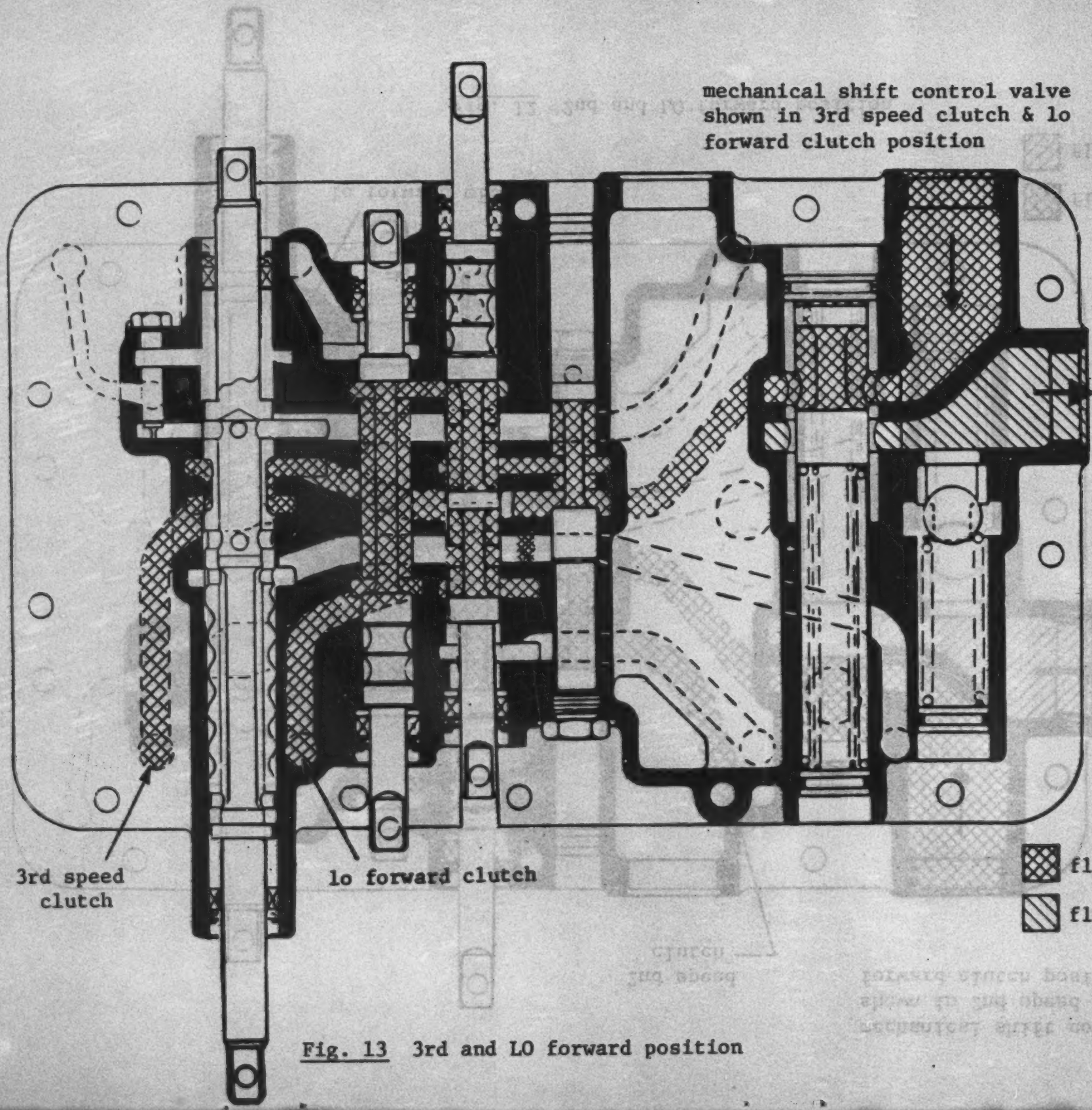

mechanical shift control valve shown in 3rd speed clutch & lo forward clutch position
3rd speed clutch
lo forward clutch
flow to clutches
flow to converter

Fig. 13 3rd and LO forward position

mechanical shift control valve shown in 4th speed clutch & lo forward clutch position

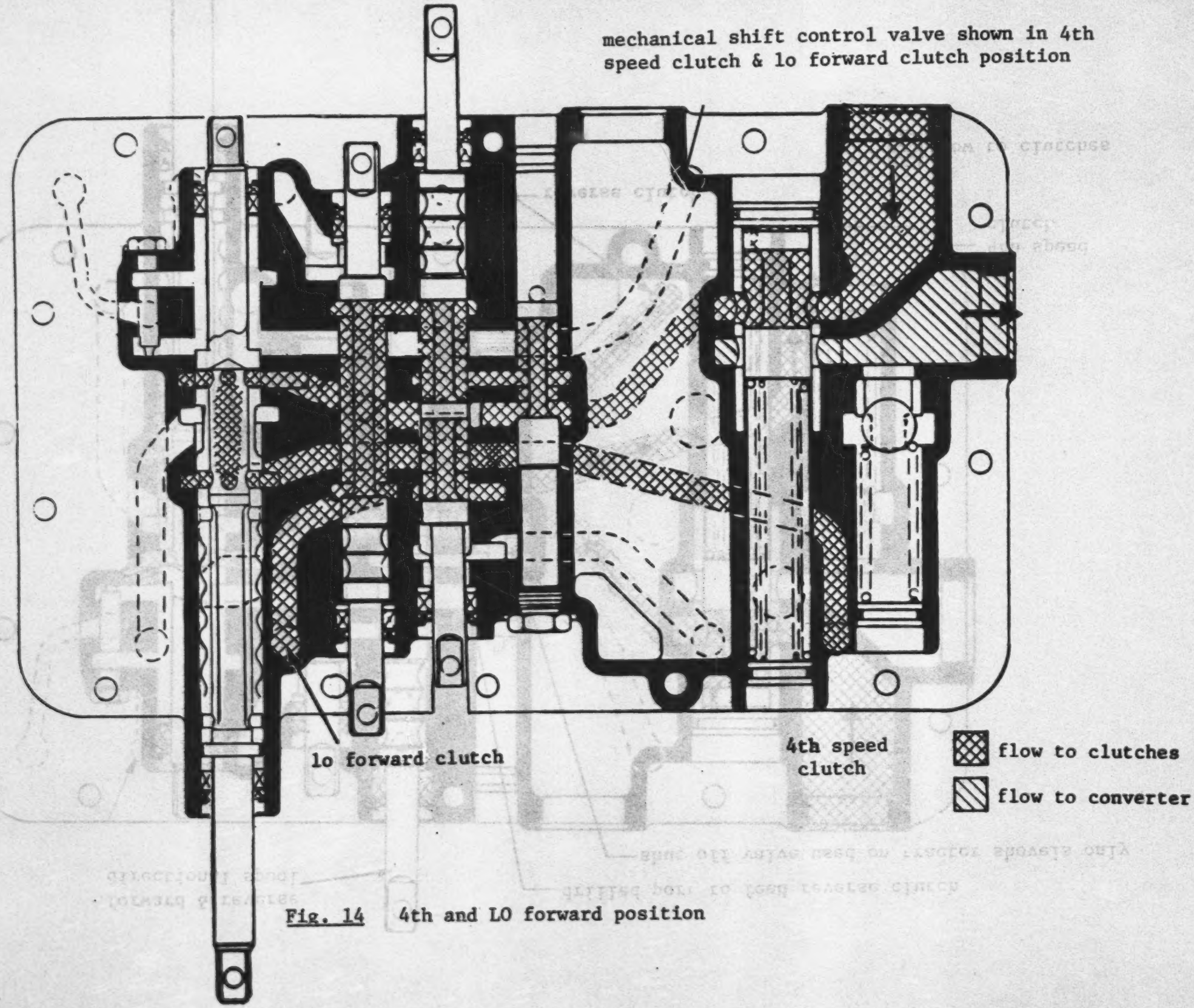


Fig. 14 4th and LO forward position

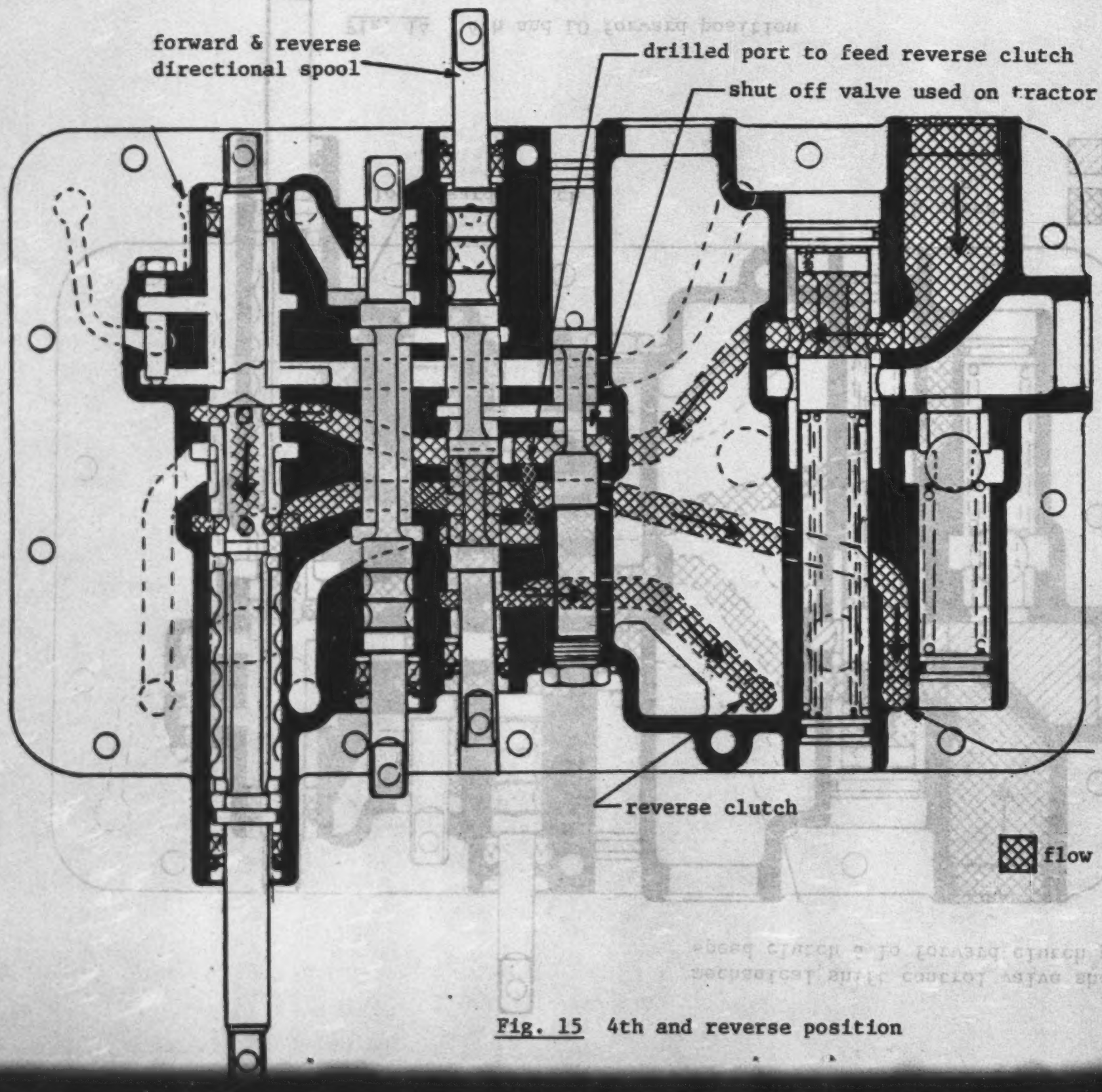


Fig. 15 4th and reverse position

Figure 15 shows the oil supply to 4th speed clutch. If the directional spool were shifted downward, oil would be blocked from going to the HI and LO forward spool and would be directed to the reverse clutch. The vehicle then would be traveling backwards at 0-21. 8 mph. Also note, that oil is flowing to the reverse clutch, even though the shutoff valve may be in the shutoff position. The reason for the drilled passage to the reverse clutch is so that if a dumping operation were taking place, the operator could reverse the vehicle even though his foot is on the brake pedal.

DIDACTOR PLATES FOR AM 2-22D

	1st	2nd	3rd	4th	5th	6th	7th	8th
Forward mph	0-3.8	0-5.1	0-6.9	0-9.1	0-12.2	0-16.0	0-21.8	0-28.8
Reverse mph	0-3.8	---	0-6.9	---	0-12.2	---	0-21.8	---

(a) travel speed ranges

FORWARD SPEEDS

1st gear	LO Forward and 1st speed clutch
2nd gear	HI Forward and 1st speed clutch
3rd gear	LO Forward and 2nd speed clutch
4th gear	HI Forward and 2nd speed clutch
5th gear	LO Forward and 3rd speed clutch
6th gear	HI Forward and 3rd speed clutch
7th gear	LO Forward and 4th speed clutch
8th gear	HI Forward and 4th speed clutch

REVERSE SPEEDS

1st gear	Reverse and 1st speed clutch
2nd gear	Same as 1st gear on shift levers
3rd gear	Reverse and 2nd speed clutch
4th gear	Same as 3rd gear
5th gear	Reverse and 3rd speed clutch
6th gear	Same as 5th gear
7th gear	Reverse and 4th speed clutch
8th gear	Same as 7th gear

(b) clutch engagement

Plate I Travel speed ranges and clutch engagement

"A" PUMP OUT PUT
"B" CLUTCH PRESSURE
"C" CONVERTER IN PRESSURE
"D" CONVERTER INTERNAL PRESSURE
"E" COOLER IN PRESSURE
"F" LUB PRESSURE
"G" CONVERTER LEAKAGE
"H" TRANSMISSION LEAKAGE

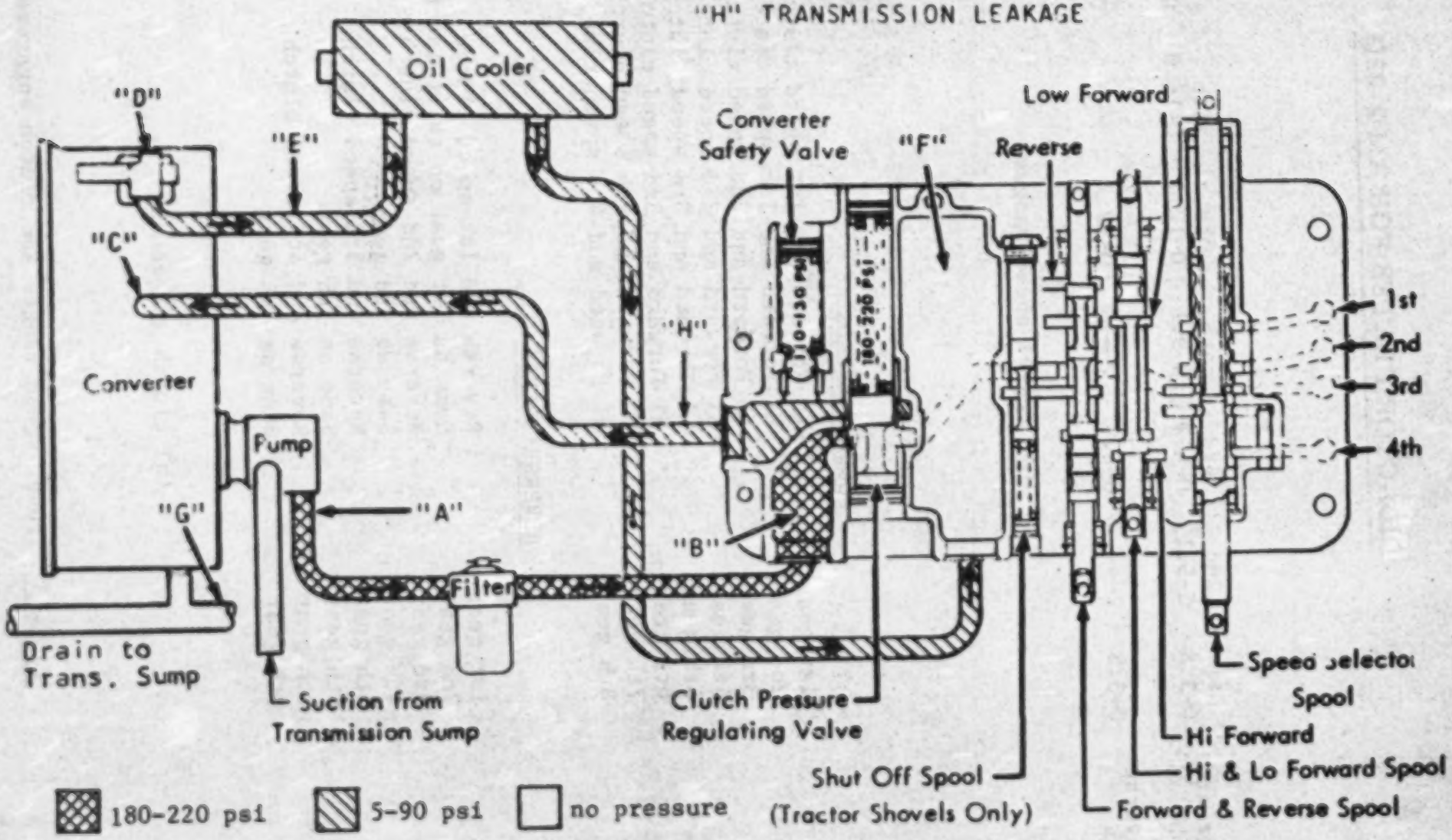


Plate II

0

AM 2-22D
10/26/67

MICHIGAN/CLARK TRANSMISSION --
TRANSMISSION AND CONVERTER FUNCTION

Human Engineering Institute

Minn. State Dept. of Ed.
Vocational Education

Press A 1

Check to see that timer and index are OFF.

1

In this film we will continue our discussion of the Michigan/Clark Power Shift Transmission and Converter.

We will discuss the construction and operation of the converter and transmission assemblies, and how oil pressure is maintained in them. We will also discuss converter stall and oil pressure through the cooler assembly.

Press A 2

1-1

2

The vehicle axle assemblies receive power from the engine through the Michigan/Clark torque converter and the power shifted, eight speed forward, four speed reverse automatic transmission.

The power multiplication factor for the converter section is _____ to one.

A. three 4
B. four 3
C. two 3

1-2

3

You are incorrect.

The torque multiplication ratio for the converter section of the Michigan/Clark system is 3 to 1.

This means that although the rpm's are reduced to one-third that of engine speed, the TORQUE is multiplied three times.

Press A 4

1-3

4

OK.

The torque converter accepts rotating mechanical energy from the engine, converts it temporarily to hydraulic energy and then back to rotating mechanical energy (torque).

The Michigan/Clark converter consists of four members. The _____ is called the DRIVING member.

A. drive disc 5
B. reaction member 5
C. turbine 5
D. impeller 6

1-4

5

Incorrect.

In the Michigan/Clark converter, the driving member is the IMPELLER.

The impeller also serves as a pump for the oil that drives the other rotating member of the converter.

Press A 6

1-5

6

OK.

A gear is splined on the impeller hub, driving through gears which rotate the hydraulic pumps mounted on the converter housing cover.

The impeller and the drive disc members form the outer shell of the converter assembly.

Press A 7

1-6

7

Mechanical rotation is transferred from the impeller to the ___(1)___, which is the driven member. This rotation (torque) is transmitted by ___(2)___ linkage.

A. (1) reaction member (2) mechanical 8
B. (1) turbine (2) hydraulic 10
C. (1) turbine (2) mechanical 9
D. (1) reaction member (2) hydraulic 9

1-7

8

Both parts of your answer are incorrect.

The impeller (driving member) transfers torque to the TURBINE, which is the driven member.

The only direct connection between the impeller and the turbine is oil, so we say that they are linked HYDRAULICALLY.

Press A 10

1-8

9

Only part of your answer is correct.

The impeller transmits torque to the TURBINE, which is the driven member.

Since the only direct connection between the two is oil, we say that they are linked HYDRAULICALLY.

Press A 10

1-9

10

OK.

One member of the converter assembly is splined on a fixed support and does not rotate in either direction.

It is called the _____.

A. drive disc 11
B. reaction member 12

1-10

11

No.

The drive disc forms part of the outer shell of the converter (along with the impeller). It couples the converter to the engine.

The member which is splined on a fixed support and does not rotate is called the REACTION MEMBER.

Press A 12

1-11

12

OK.

The fixed member of the converter assembly is the reaction member.

The turbine runs within the outer shell and is connected to the converter output shaft.

If you would like a brief review of this introduction to the converter, press A. Otherwise, press B.
2 14

X(C)-13

1-12

13

OK.
The reaction member is the fixed member of the converter assembly.

Since you have made an error on a question or two so far, let's have a brief review of this introduction to the converter.

Press A 2

1-11

14

Now let's look at the transmission section.

The Michigan/Clark transmission is a power shift unit with eight speeds forward and four speeds reverse.

The unit is fully power shifted through ___(1)___ actuated, ___(2)___ disc clutches.

A. (1) mechanically (2) single 15
B. (1) hydraulically (2) single 16
C. (1) hydraulically (2) multiple 17
D. (1) mechanically (2) multiple 16

2-14

15

Both parts of your answer are incorrect.

The Michigan/Clark transmission is fully power shifted through the action of HYDRAULICALLY actuated, MULTIPLE disc clutches.

Press A 17

2-15

16

Only part of your answer is correct.

The Michigan/Clark transmission is fully power shifted through the action of HYDRAULICALLY actuated, MULTIPLE disc clutches.

Press A 17

2-16

17

OK.

The design allows the operator to power shift into any desired speed range and direction, merely by moving the levers on the steering column.

The transmission gears are in CONSTANT mesh.

Press A 16

2-17

18

For ease of discussion, the gear box can be considered to be made up of two halves.

The upper half consists of the forward and reverse shafts and clutches.

These drive the _____ shaft in the desired direction.

A. output 19
B. idler 20

2-18

19

Incorrect.

The transmission output shaft is part of the LOWER half of the gear box.

The forward and reverse shafts and clutches (in the upper half of the gear box) drive the IDLER shaft in the desired direction.

Press A 20

2-19

20

OK.

The lower half of the transmission gear box is the SPEED section. It receives power from _____ of the idler shaft.

A. both ends 22
B. only one end 21

2-20

21

No.

Power is transmitted BOTH by the forward end of the idler shaft (to the first and second clutches) and by the rear end of the idler shaft (to the third and fourth clutches).

Press A 22

2-21

22

OK.

If the first or second clutches are applied, power is transmitted from the idler shaft pinion gear (located on the forward end of the idler shaft) to the large gear on the clutch drum. From there it passes through the appropriate clutch and shaft and through the final gears to the output shaft.

Press A 23

2-22

23

If the third or fourth clutches are applied, they are driven by the large gear at the rear end of the idler shaft. Power is then transmitted to the output shaft by way of the appropriate clutch and shaft and the final gears.

Press A 24

2-23

24

The first and second clutches receive power from the ____(1)____ end of the idler shaft. The third and fourth clutches receive power from the ____(2)____ end of the idler shaft.

A. (1) forward (2) rear 26
B. (1) rear (2) forward 25

2-24

25

You are incorrect.

Perhaps you missed the information that would have helped you answer the question correctly.

Let's review briefly; then you can try the question again.

Press A 22

2-25

26

OK.

Power from the transmission output shaft is transferred to the axle ring gears and pinion, and flows out to the planetary gears (included on certain models).

The planetaries are located on the outer ends of the axles. They apply the driving force to the vehicle wheels.

Press A 27

2-26

27

There are a total of seven clutches in the Michigan/Clark power shift transmission. The clutches are as follows:

1st SPEED CLUTCH
2nd SPEED CLUTCH
3rd SPEED CLUTCH
4th SPEED CLUTCH
LO FORWARD CLUTCH
HI FORWARD CLUTCH
REVERSE CLUTCH

Press A 28

2-27

28

As in the Allison transmission, TWO clutches must be engaged in the Michigan/Clark unit before the vehicle will move.

One of the two clutches will determine the speed range; the other clutch will determine the direction of travel.

Press A 29

2-28

29

VEHICLE SPEED AND DIRECTION

See Plate I.

In order to obtain vehicle speeds of from 0 to 3.8 mph, the _____ clutch and the first speed clutch must be engaged.

A. LO forward 31
B. HI forward 30

2-29

30

You are incorrect. (See Plate I.)

Engaging the HI forward clutch and the first speed clutch gives you second gear and a vehicle speed range of 0-5.1 mph.

To obtain first gear (vehicle speed 0-3.8 mph) the first speed clutch and the LO forward clutch must be engaged.

Press A 31

2-30

31

OK. Engaging the LO forward clutch and the first speed clutch gives you first gear (forward).

Various other combinations of the HI and LO forward clutches and the speed clutches are needed to obtain other forward speeds. See Plate I.

Press A 32

2-31

32

For example:

With the third speed clutch and the LO forward clutch engaged, __(1)__ gear is obtained. If the HI forward clutch is engaged along with the third speed clutch, _(2)_ gear is obtained.

A. (1) third (2) fourth 33
B. (1) fifth (2) sixth 35
C. (1) third (2) fifth 34

2-32

33

No. See Plate I (b). Third and fourth gears are obtained by engaging the second speed clutch and either the LO forward clutch (for third gear), or the HI forward clutch (for fourth gear).

Engaging the third speed clutch and the LO forward clutch gives you FIFTH gear. Switching to HI forward then gives you SIXTH gear.

Press A 35

2-33

34

No. See Plate I (b). The third speed clutch is NOT engaged to obtain third gear. Third gear is obtained by engaging the LO forward and the second speed clutches.

Engaging the third speed clutch and the LO forward clutch gives you FIFTH gear. Switching to HI forward then gives you SIXTH gear.

Press A 36

2-34

35

OK.

The eight forward speeds are obtained by engaging either the HI forward or LO forward clutch, along with one of the four speed clutches.

The four reverse speeds are obtained by engaging the reverse clutch and one of the four speed clutches.

If you would like to review this introduction to the transmission section, press A. Otherwise, press B.

14 37

X(C)-36

2-35

36

OK.

The eight forward speeds are obtained by engaging either the HI forward or LO forward clutch, and one of the four speed clutches.

The four reverse speeds are obtained by engaging the reverse clutch and one of the four speed clutches.

Let's review this brief introduction to the transmission section, since you had trouble with a question or two.

Press A 14

2-36

37

Let's see how oil pressure is maintained in the Michigan/Clark converter and transmission system.

Pressure in the system is regulated by the CLUTCH REGULATING VALVE SPRING and the CONVERTER REGULATING VALVE SPRING. After the oil exits from the converter, pressure in the lines is created by RESISTANCE in the lube manifold and cooler, and in the lines going to and from the cooler.

Press A 38

3-37

38

The clutch regulating valve spring maintains a pressure of _____ psi when compressed.

A. 60 to 80 40
B. 110 to 130 39
C. 180 to 220 41

3-38

39

No. (See Plate II.)

The converter safety valve is set for 110 to 130 psi. This valve operates to unload the converter if the cooler becomes plugged or if the downstream regulating valve becomes stuck in the closed position.

What pressure does the clutch pressure regulating valve maintain? (See Plate II.)

Press A 38

3-39

40

No.

You may be thinking of the pressures at the converter under varying conditions. We'll talk about those shortly.

Now, what pressure does the clutch pressure regulating valve maintain? (See Plate II.)

Press A 38

3-40

41

OK.

The clutch pressure regulating valve maintains 180 to 220 psi on the clutches whenever the engine and pump are operating.

This pressure is from the pump to the clutches and can be checked at _____ as shown on Plate II.

A. location "F" 42
B. location "B" 43
C. location "H" 42

3-41

42

No. If you said location "F" or location "H", you are incorrect.

Location "F" gives you transmission lube pressure; location "H" is the measuring point for transmission leakage.

The pressure from the pump to the clutches (180-220 psi) is measured at location "B". (See Plate II.)

Press A 43

3-42

43

OK. Oil is directed into the control cover at location "B", and then through the clutch pressure regulating valve to the clutches.

When the clutch regulating valve spool moves, (after the clutches have been satisfied), it compresses the regulating valve spring until a port is exposed alongside the bore. This allows the oil to exit from the control cover and enter the converter at location "C". (See Plate II.)

Press A 44

3-43

44

The converter regulating valve (mounted on the OUTLET side of the converter) is a hardened spool valve operating in a close fitting bore, much the same as the clutch pressure regulating valve.

The spool in the converter regulating valve is backed up by a spring, which helps it to hold oil in the converter cavity until a specified pressure is reached.

Press A 45

3-44

45

The purpose of the converter regulating valve is to maintain a minimum of _____psi converter internal pressure, to assure proper performance under all operating conditions.

A. 90 46
B. 80 47
C. 60 48

3-45

46

You are incorrect.

The converter regulating valve normally is set to maintain a minimum of 60 psi internal pressure in the converter under all operating conditions.

Press A 48

3-46

47

You are incorrect.

At high engine speed (2000 rpm), the converter in pressure would be about 80 psi. We'll talk more about that shortly.

The converter regulating valve normally is set to maintain a minimum of 60 psi in the converter under all operating conditions.

Press A 48

3-47

48

OK.

The converter regulating valve maintains a minimum of 60 psi converter internal pressure.

See Plate II. If you install gauges at locations "C" and "D", you will obtain a reading of at least 60 psi at both locations at low engine speeds.

Press A 119

3-48

49

If engine speed is then increased to 2000 rpm, the pump will then be displacing 31 gpm (on units equipped with a 31 gallon pump). Twenty-nine gpm will flow into the converter and two gpm will go to maintain clutch pressure.

Press A 50

3-49

50

See Plate II.

With the engine turning at 2000 rpm and the forward-reverse shift lever in neutral:

Pressure at location "C" will be about (1) psi and pressure at location "D" will be (2) psi.

A. (1) 60 (2) 80 57
B. (1) 80 (2) 60 53
C. (1) 60 (2) 60 52

3-50

51

No. You have the correct answers reversed.

At 2000 engine rpm, with the forward-reverse shift lever in neutral, pressure at location "C" (converter in pressure) climbs from its former value of approximately 60 psi to 80 psi.

Pressure at "D" (controlled by the converter regulating valve) is 60 psi under all speed conditions.

Press A 53

3-51

52

Not quite. (See Plate II.)

Remember that the converter regulating valve maintains a steady pressure inside the converter of 60 psi (measured at location "D").

At LOW engine speeds, the converter in pressure (measured at location "C") is approximately 60 psi. At high engine speed, the pressure at "C" climbs to about 80 psi, due to increased oil volume flow.

Press A 54

3-52

53

OK.

Converter in pressure is about 60 psi at low engine speeds, and about 80 psi at 2000 rpm.

The turbine in the converter turns at approximately the same speed as the vehicle engine and the impeller, when the forward-reverse lever is in neutral.

Press A 55 X(C)-54

3-53

54

OK. Converter in pressure is about 60 psi at low engine speeds, and about 80 psi at 2000 rpm. It is measured at location "C" as noted in Plate II.

Converter internal pressure is checked at location "D" and normally is 60 psi under all speed conditions.

Let's have a quick review now, since you have missed a question or two in this section on system oil pressure.

Press A 37

3-54

55

CONVERTER STALL

If the direction selector lever is shifted into either forward or reverse, the speed selector lever shifted into the eighth speed range, and the drive wheels blocked by applying the parking brake, the converter will stall if the engine is accelerated to full throttle.

Under stall conditions, the pressure at location "D" (Plate II) will remain at 60 psi. The pressure at "C", however, will drop to slightly below 60 psi.

Press A 56

4-55

56

See Plate II.

Under converter stall conditions, the pressure at location "C" will be (1) ; the pressure at "D" will be (2) .

A. (1) slightly higher than 60 psi (2) slightly lower than 60 psi 57

B. (1) 60 psi (2) slightly lower than 60 psi 58

C. (1) slightly lower than 60 psi (2) 60 psi 59

4-56

57

Both parts of your answer are incorrect. See Plate II.

The pressure at location "C" will fall slightly below 60 psi. The pressure at location "D", however, will remain at 60 psi. Remember, pressure at "D" is 60 psi under ALL operating conditions.

Press A 59

4-57

58

You have the correct answers reversed. (See Plate II.)

Under converter stall conditions:

The pressure at location "D" will remain at its normal level of 60 psi. The converter regulating valve maintains 60 psi under all conditions, including converter stall.

At location "C", however, the pressure drops to slightly below 60 psi during converter stall.

Press A 59

4-58

59

OK.

The reason for the drop in pressure at location "C" during converter stall is that the turbine is stopped and the impeller is pumping maximum oil volume against it, attempting to make the turbine rotate and drive the wheels.

Press A 60

4-59

60

Due to the pumping action of the impeller, oil from the turbine exits through the reaction member and re-enters the impeller (under full stall conditions).

Oil, leaving the reaction member for the impeller, flows across the converter inlet port. When this occurs, there is a slight drop in _____pressure.

A. converter in 62

B. converter internal 61

4-60

61

No.

Keep in mind what we have said earlier -- converter internal pressure normally is maintained at a steady 60 psi by the converter regulating valve.

When oil flows across the converter inlet port during full stall, there is a slight drop in the converter in pressure.

Press A 62

4-61

62

OK.

The oil flow speeds up temporarily across the inlet port, and converter in pressure drops to slightly below 60 psi under full converter stall.

In any hydraulic system, when the flow rate increases at a given point, there is a corresponding DEcrease in pressure at that point.

Press A 63

4-62

63

Converter stall occurs when the _____ are held temporarily stationary and the engine is run at full throttle.

A. impeller and the reaction member 64

B. turbine and the transmission output shaft 66

C. impeller and the drive disc 65

4-63

64

You are incorrect.

Remember that the impeller is pumping maximum volume during converter stall. It could not do this if it were being held stationary.

Also, keep in mind that the reaction member is splined on a fixed support. It never rotates.

Think about how the converter may be stalled intentionally and try the question again.

Press A 63

4-64

65

Your answer is incorrect.

Remember that the drive disc connects the vehicle engine to the converter, and that the engine is run at full throttle during converter stall. Keep in mind that the impeller pumps maximum volume during full stall.

With these things in mind, try the question again.

Press A 63

4-65

66

OK.

The turbine and the output shaft are not free to rotate normally under converter stall conditions.

The maximum allowable time for sustained converter stall is _____.

A. one minute 68
B. ten seconds 67
C. thirty seconds 69

4-66

67

No.

Converter stall can be sustained slightly longer than ten seconds with relatively little danger.

But the maximum allowable time for sustained converter stall is 30 SECONDS.

Press A 69

4-67

68

Incorrect.

Converter stall sustained for any longer than 30 SECONDS may cause damage to the converter and/or transmission.

Press A 69

4-68

69

OK.

Never maintain converter stall for longer than 30 seconds at a time!

Holding stall for longer than 30 seconds may result in damage to the converter and/or transmission. The converter and transmission seals may be damaged, primarily due to excessive _____ build-up.

A. heat 71
B. pressure 70

4-69

70

No.

The primary danger to the converter and transmission seals during converter stall is from excessive HEAT. The heat comes primarily from the violent swirling of oil as it is driven against the stalled turbine by the impeller.

Press A 72

4-70

71

OK. Excessive heat is the biggest danger during converter stall.

If you would like to review this section on converter stall, press A 55

Press B 37 if you would like your review to include our discussion of oil pressure in the converter and transmission. X(Q-72

Press D if you prefer to go on.

73

3-71

10

72

OK. Heat build-up during converter stall may damage transmission or converter seals.

Let's have a quick review of converter stall, since you have made an error on one or two questions.

Press A 55

4-72

73

OIL COOLER

After oil exits from the converter it flows directly to the cooler.

Resistance in the oil lines running to and from the cooler creates about 5 to 10 psi pressure when there is about 26 gpm oil flow from the converter.

Press A 74

5-73

74

If the original volume flow through the converter supply pump is 31 gpm, and if only 26 gpm flow from the converter to the cooler, what has happened to the remaining five gpm?

A. Five gpm are needed to actuate the clutches 75
B. Two gpm lubricate the supply pump gears; three gpm leak past the clutch seals 75
C. Three gpm lubricate the supply pump gears; two gpm leak past the clutch seals 76

5-74

75

No. This was a review question from the preceding film.

From the original volume flow through the supply pump (31 gpm), three gpm are used to lubricate the supply pump gearing, and two gpm are used to help maintain clutch pressure (through leakage around the clutch seals).

This leaves 26 gpm flowing from the converter to the cooler.

Press A 76

5-75

76

OK.

Baffle plates built into the cooler cause turbulence of the oil as it flows through. In this way a maximum volume of oil is exposed to the cooler water jackets, and the oil is cooled more efficiently.

These baffles create resistance to oil flow in the cooler.

Press A 77

5-76

77

Normally, pressure will be _____ on the outlet side of the cooler, compared to the cooler inlet pressure.

A. somewhat higher 78
B. somewhat lower 79
C. about the same 78

5-77

78

Incorrect.

Under normal operating conditions the pressure on the OUTLET side of the cooler is somewhat LOWER than the pressure on the inlet side.

We say that there is a pressure drop across the cooler.

Press A 79

5-78

79

OK. With the oil at normal operating temperature and the engine turning at 2000 rpm, the INLET pressure at the cooler will be about 28 psi. This pressure is created by resistance to oil flow in the lines, in the cooler and in the tubing which feeds the bearings and clutch discs.

OUTLET pressure from the cooler normally will be about 5 to 15 psi.

Press A 79.1

5-79

79.1

Oil flows from the cooler to the lube manifold. There it enters tubing inside the transmission case. Oil flow in the tubing creates pressure of approximately 5 to 15 psi, which can be read at location "F", (Plate II).

Press A 80

5-79.1

80

See Plate II.

At 2000 rpm, with the oil at normal operating temperature, pressure at location "E" will be approximately ___(1)___ psi. Pressure in the line leading to location "F" will be approximately ___(2)___ psi.

A. (1) 28 (2) 5 to 15 83
B. (1) 5 to 15 (2) 28 81
C. (1) 28 (2) 10 to 30 82

5-80

81

You have the correct answers reversed. (See Plate II).

With oil at normal operating temperature and engine speed 2000 rpm:

Pressure taken at location "E" will be approximately 28 psi. Pressure taken at location "F" will be about 5 to 15 psi.

Press A 83

5-81

82

Only part of your answer is correct. (See Plate II.)

Pressure taken at location "E" will be approximately 28 psi, as you said.

But OUTLET pressure (taken at location "F") normally will be about 5 to 15 psi. You may have been thinking of the pressure drop variation limits, which we'll talk about next.

Press A 83

5-82

83

OK.

Cooler inlet pressure normally is about 28 psi. Pressure on the outlet side usually is 5 to 15 psi.

The difference in pressure between the inlet side and the outlet side (the pressure drop across the cooler) is normally about 10 psi. The maximum allowable pressure drop is 30 psi, according to manufacturer's specifications.

Press A 84

5-83

84

Specifications for pressure drop across the cooler on systems using a 31 gallon pump are _____ _____.

A. 5 psi normal: 15 psi maximum XX
B. 10 psi normal: 30 psi maximum 85
C. 15 psi normal: 30 psi maximum XX

(Only the correct answer will move the film.)

5-84

85

OK.

Pressure drop across the cooler (at 2000 rpm) is 10 psi normal and 30 psi maximum.

If you would like a brief review of the oil cooler, press A. 73

Otherwise, press B. 87 X(C)-86

5-85

86

OK.

Pressure drop across the cooler is 10 psi normal and 30 psi maximum at 2000 rpm.

You have had a little trouble with the questions in this section, so let's have a quick review of the oil cooler.

Press A 73

5-86

87

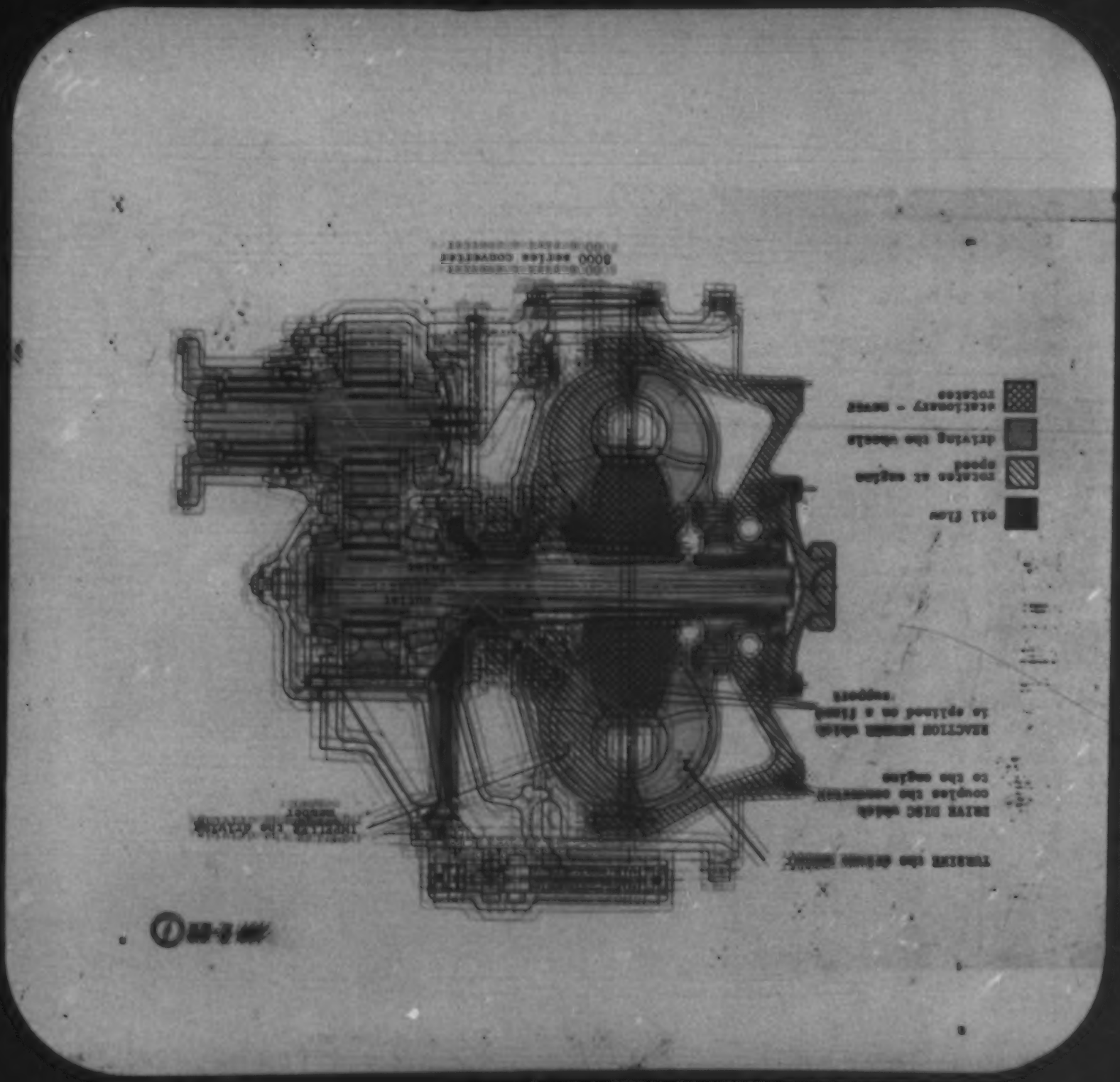
Congratulations!

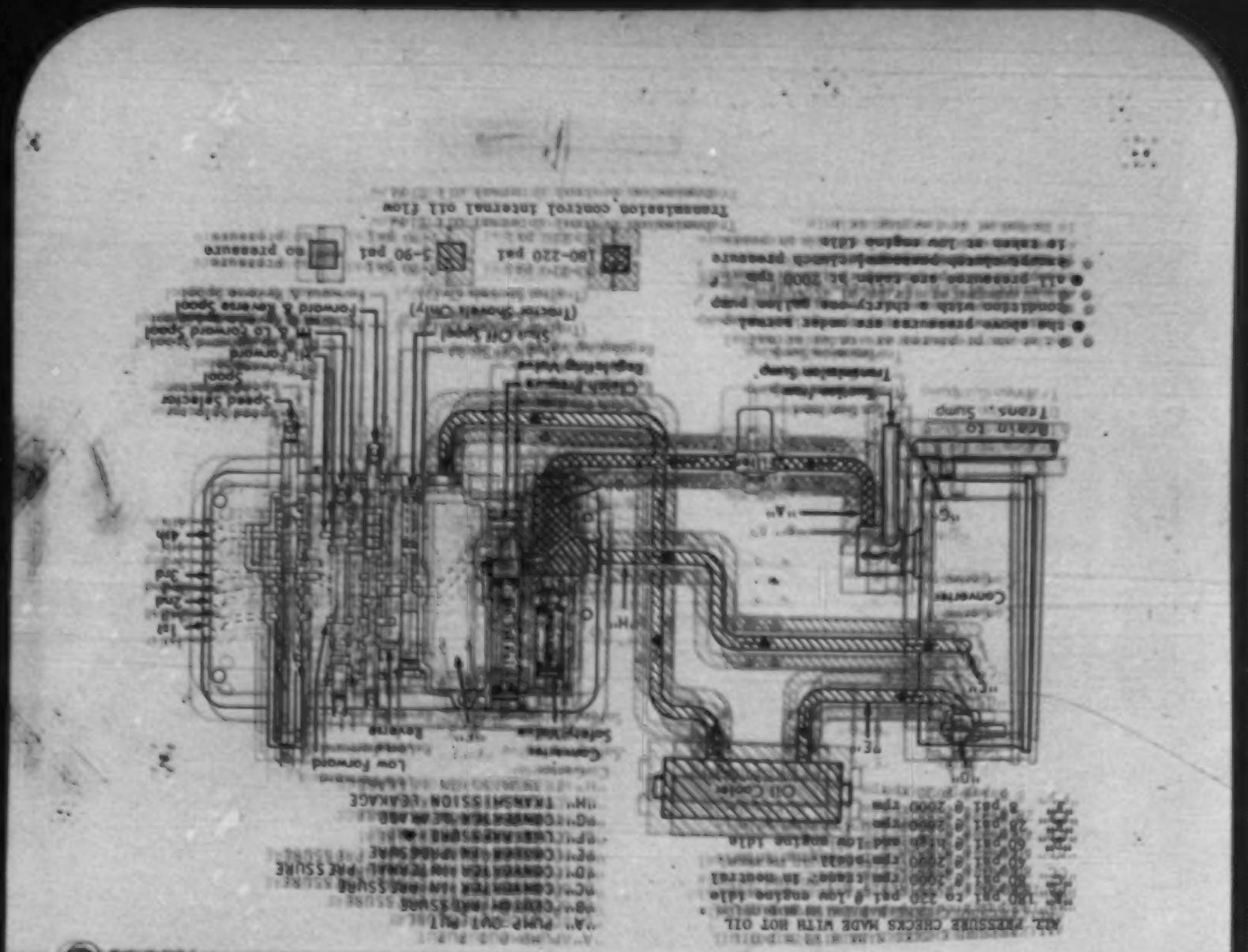
You have successfully completed this film on the "Michigan/Clark Transmission -- Transmission and Converter Function."

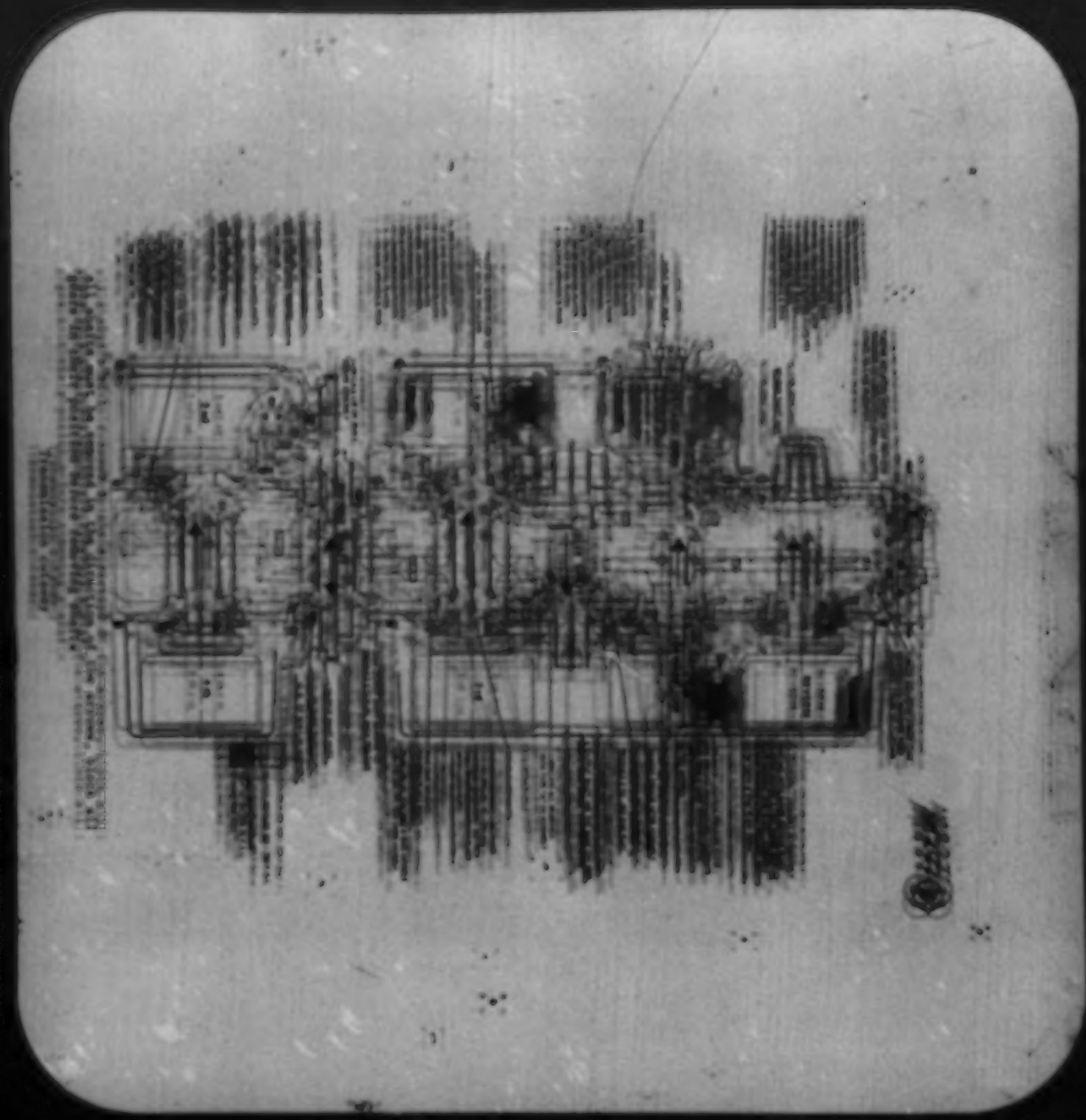
In the next film we will discuss mechanical and hydraulic shifting, and oil flow through the valves and control cover assembly.

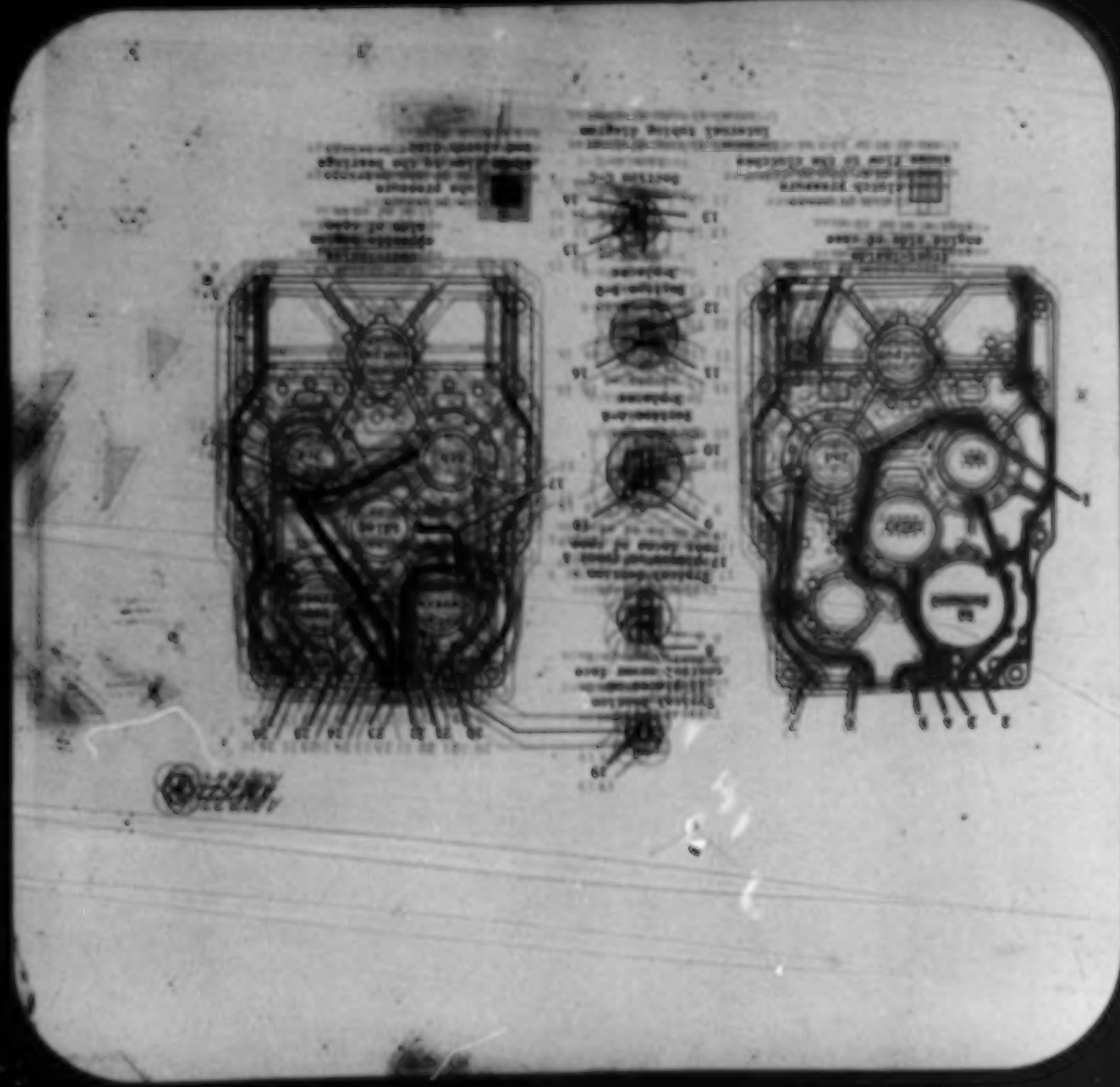
Press REWIND.

5-87

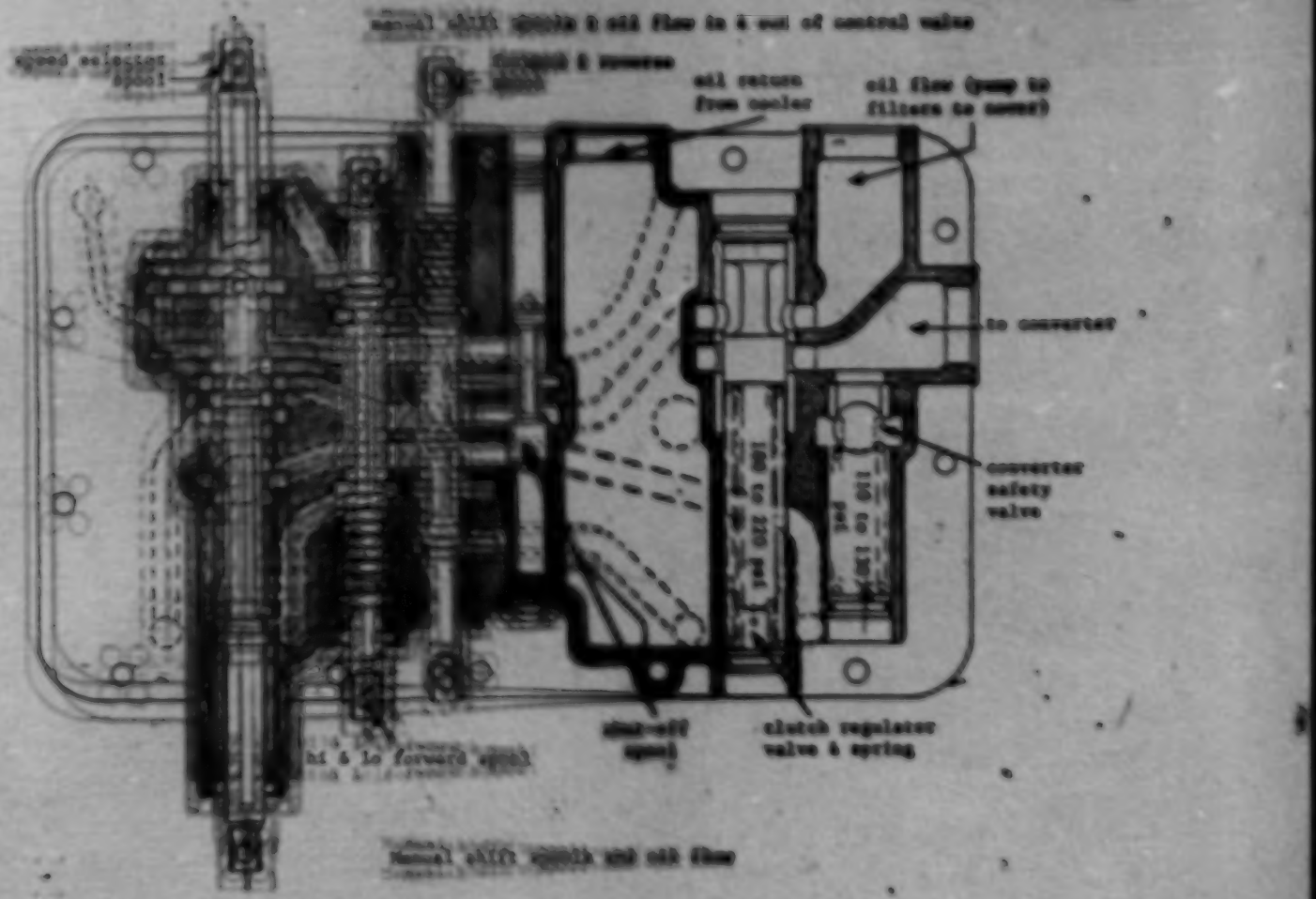

8000 series CONVERTER
TRANSFER the driven member
DRIVE DISC when coupled the converter to the engine
REACTION MEMBER when splined on a fixed support
oil flow
Rotates at engine speed
Driving the wheels
Stationary - never rotates

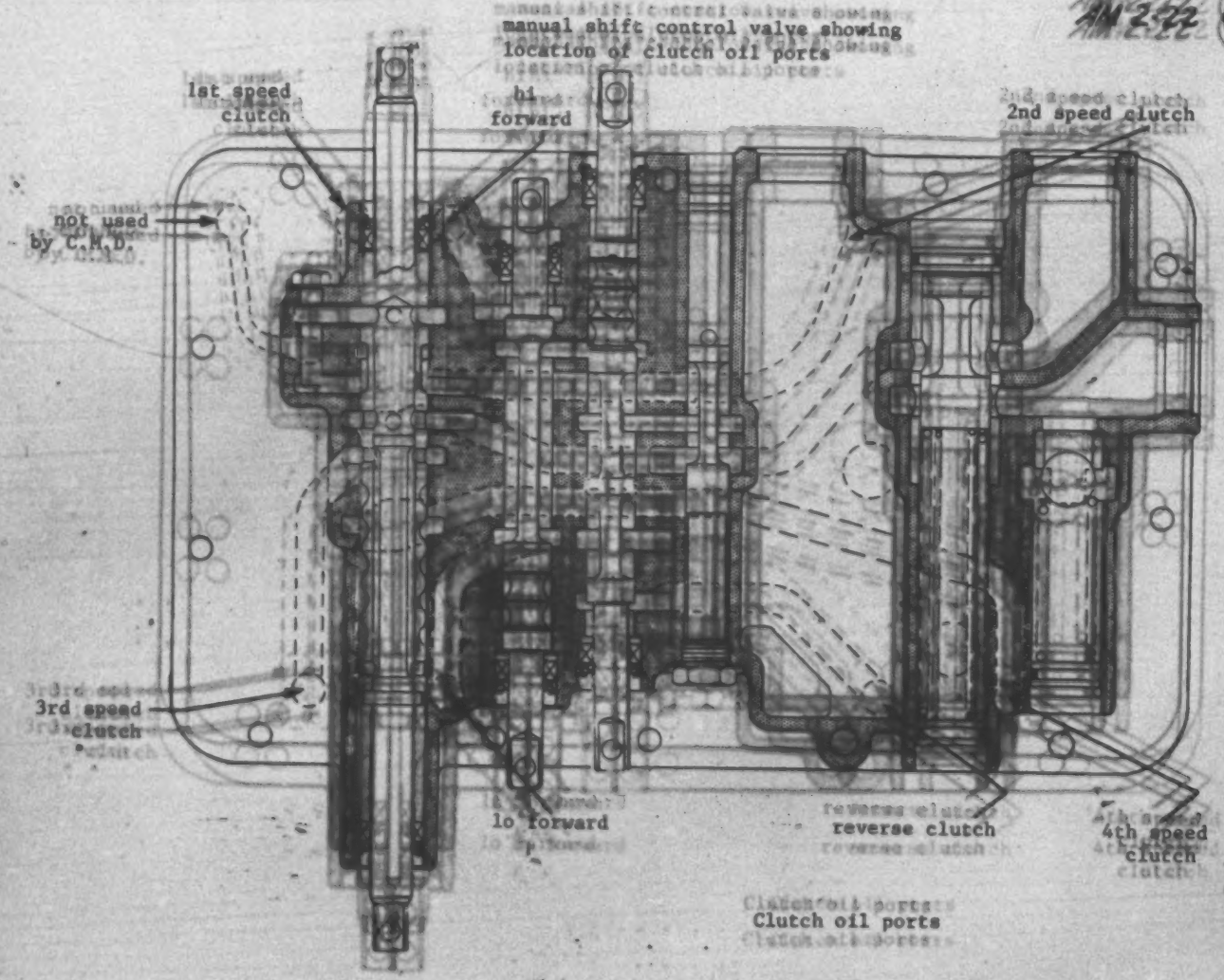


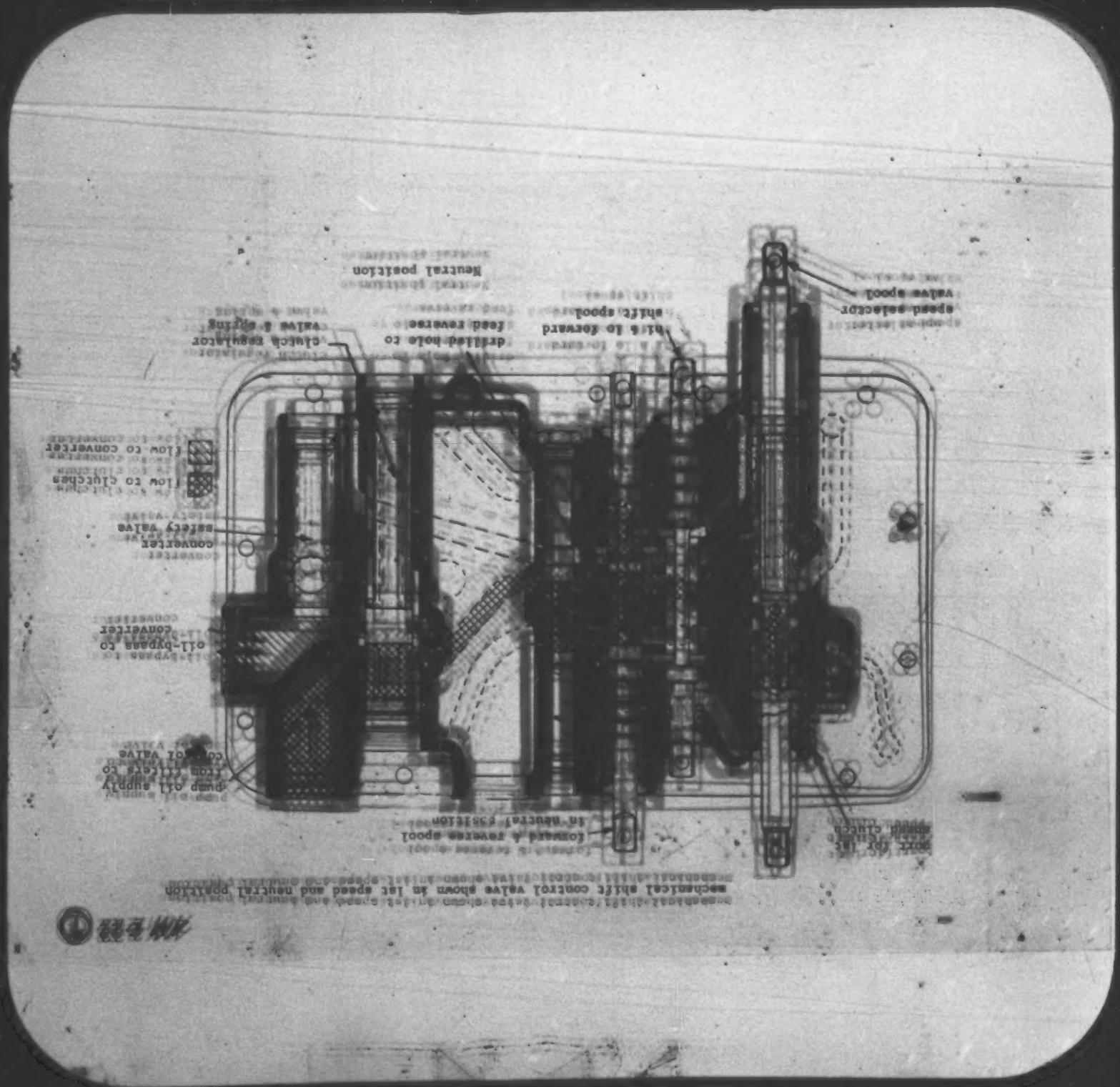


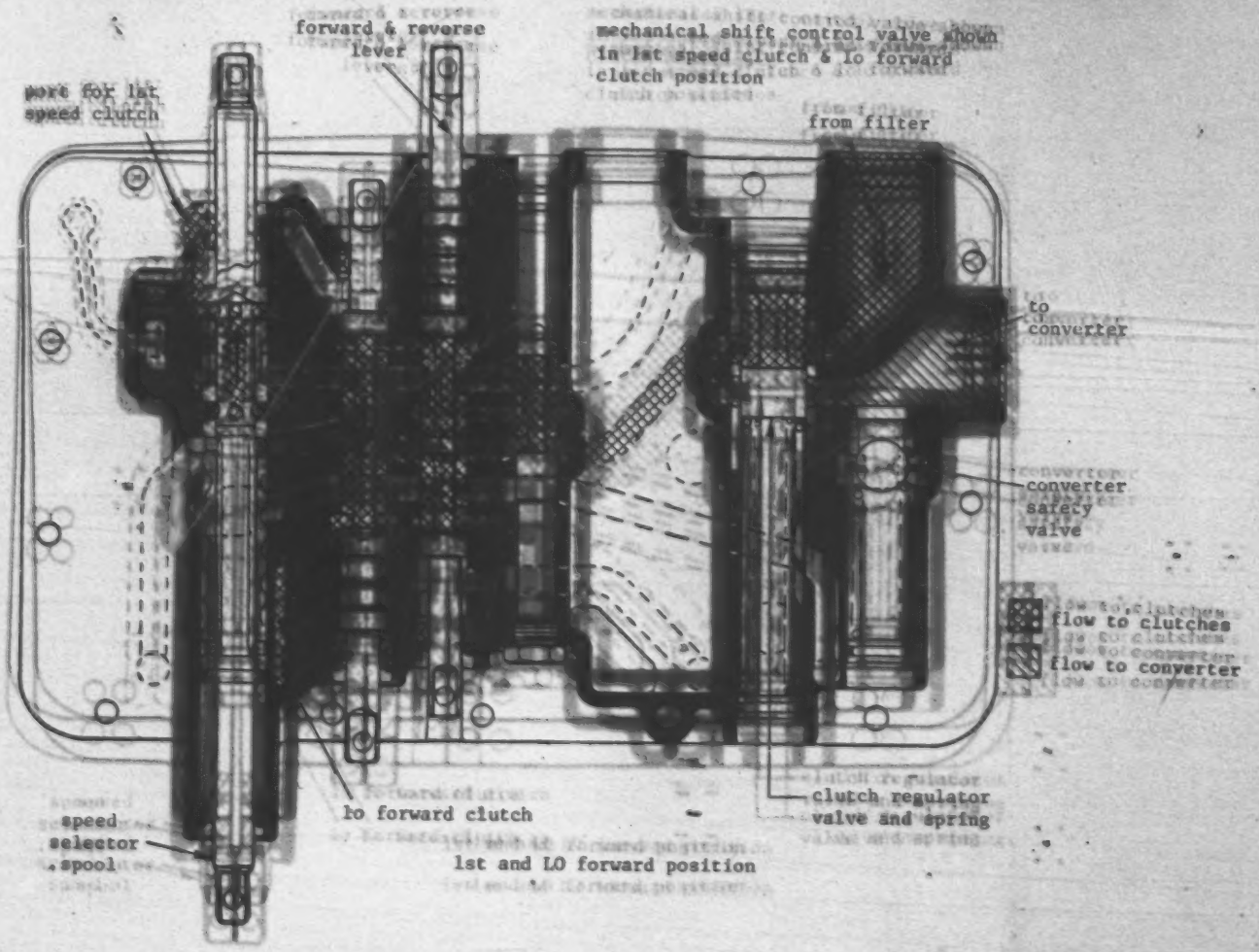


AA 8-81

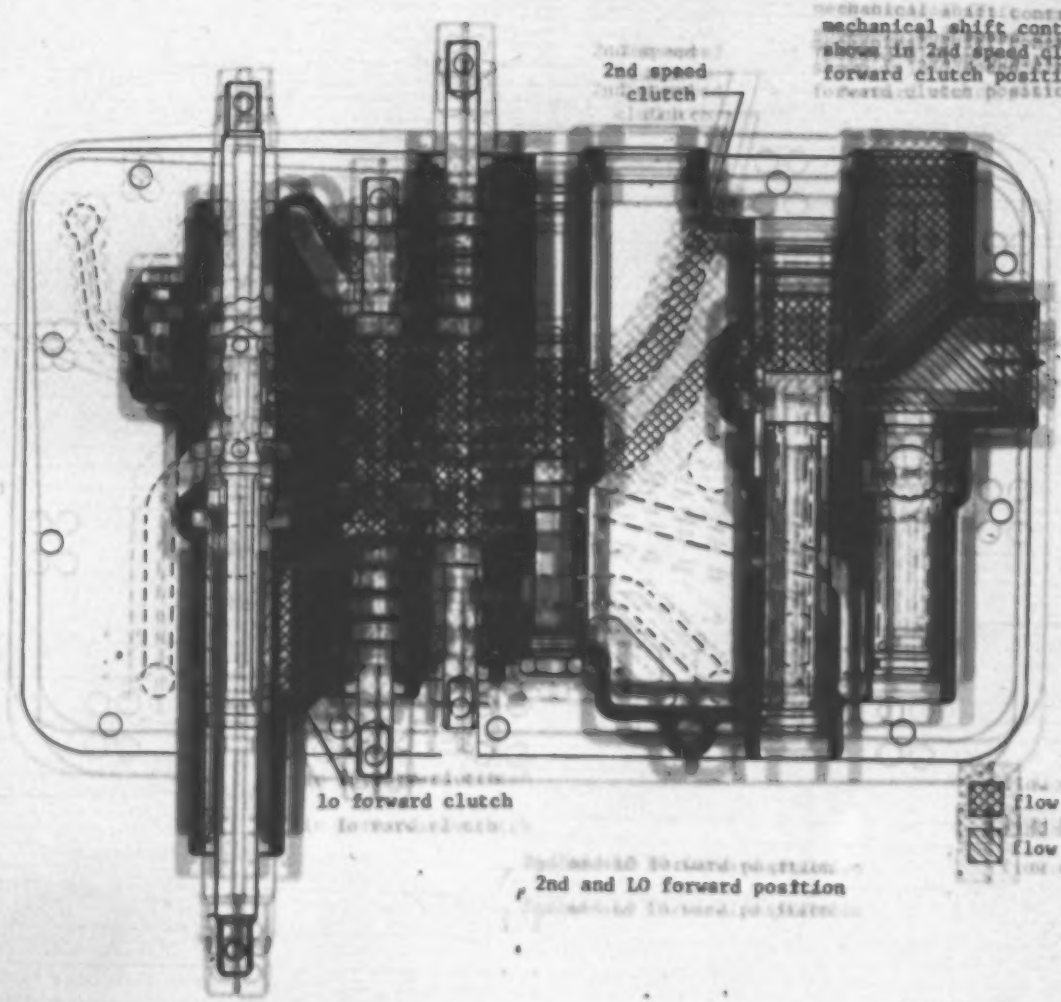

oil return from cooler
oil flow (pump to filters to cooler)
to converter
converter safety valve
clutch regulator valve & spring

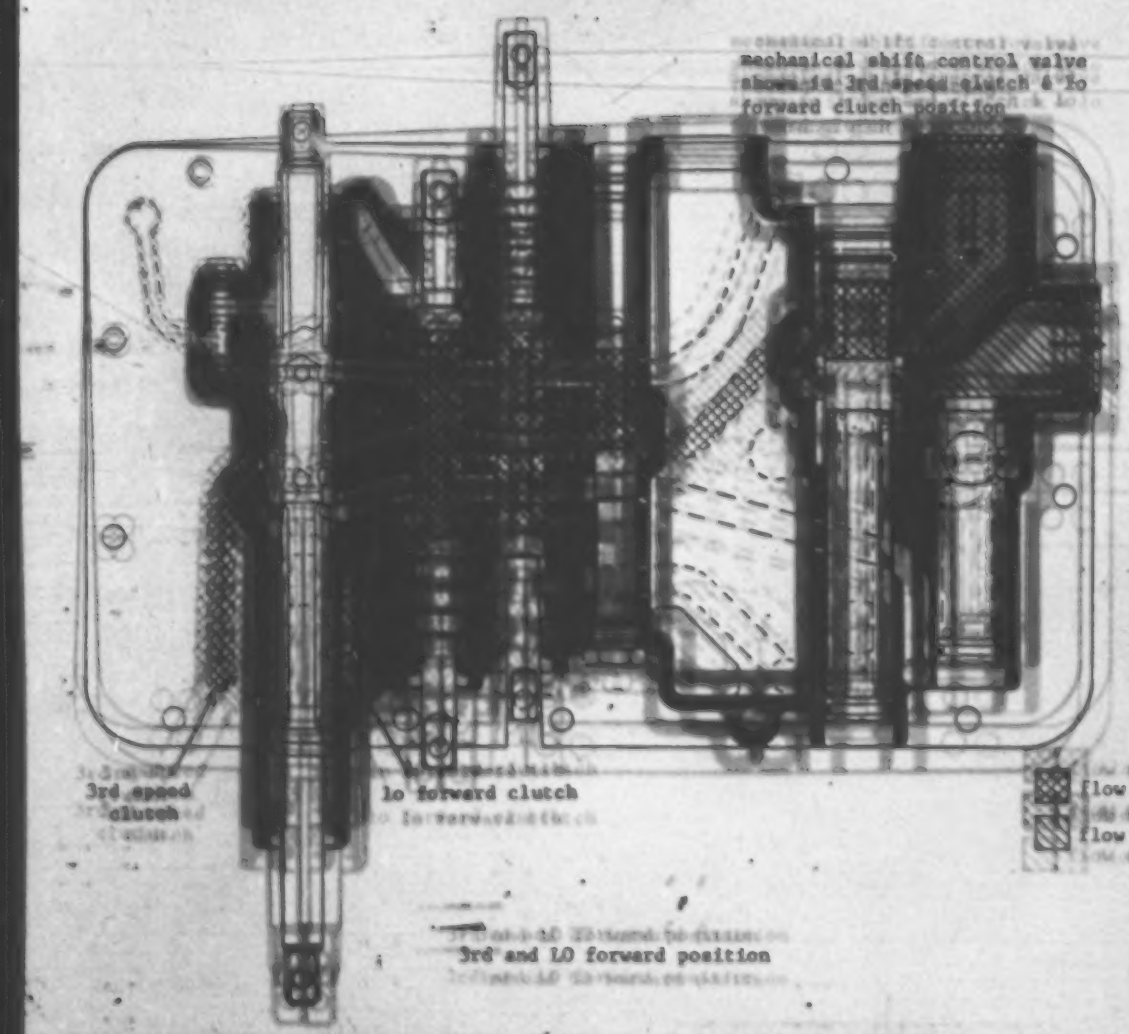

manual shift control valve showing
location of clutch oil ports
1st speed clutch
hi forward
2nd speed clutch
not used by C.M.D.
3rd speed clutch
lo forward
reverse clutch
4th speed clutch
Clutch oil ports


mechanical shift control valve shown in 1st speed and neutral position
forward & reverse spool
in neutral position
pump oil supply
from clutches to
control valve
oil-bypass to
converter
converter
safety valve
flow to clutches
flow to converter
clutch regulator
valve & spring
drilled hole to
feed reverse
Neutral position
shift spool
hub to forward
speed selector
valve spool

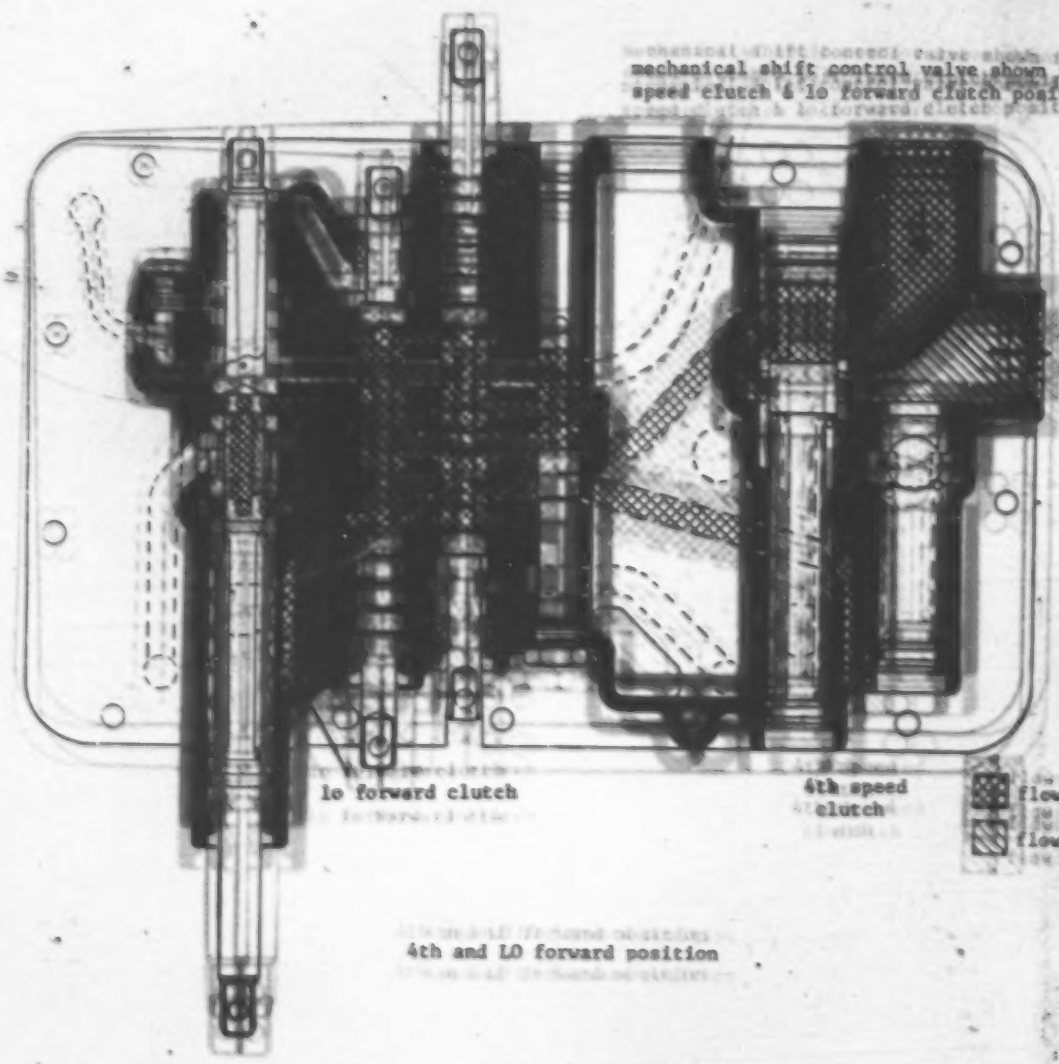

forward & reverse lever
mechanical shift control valve shown in 1st speed clutch & lo forward clutch position
port for 1st speed clutch
from filter
to converter
converter safety valve
flow to clutches
flow to converter
lo forward clutch
clutch regulator valve and spring
speed selector spool
1st and LO forward position

AMC-22


2nd speed clutch
mechanical shift control valve shown in 2nd speed clutch & lo forward clutch position
lo forward clutch
2nd and LO forward position
flow to clutches
flow to converter


mechanical shift control valve
shown in 3rd speed clutch & lo
forward clutch position
3rd speed
clutch
lo forward clutch
flow to clutches
flow to converter
3rd and LO forward position

mechanical shift control valve shown in 4th speed clutch & lo forward clutch position



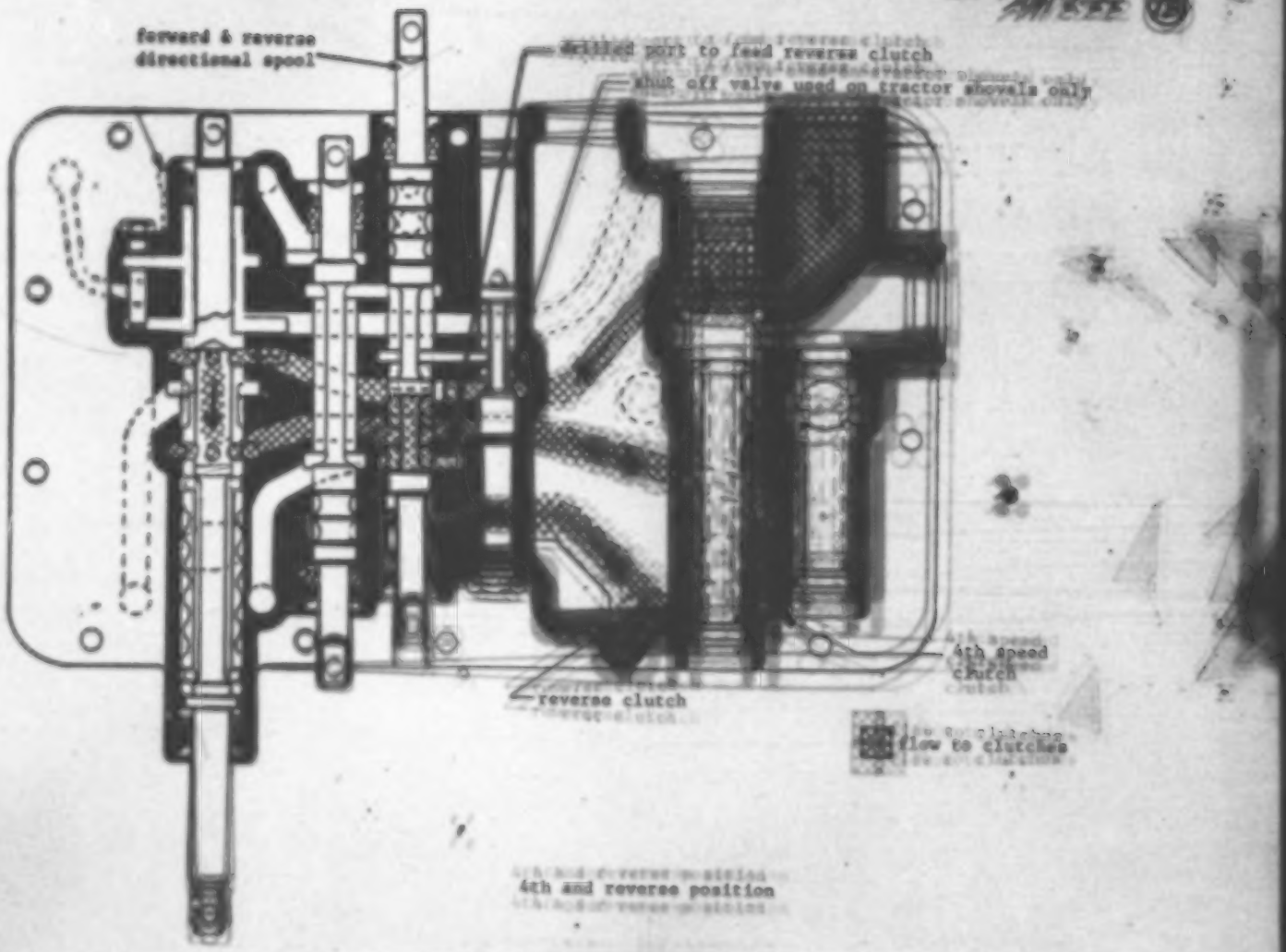
lo forward clutch

4th speed clutch

flow to clutches

flow to converter

4th and LO forward position


forward & reverse
directional spool
drilled port to feed reverse clutch
shut off valve used on tractor shovels only
4th speed
clutch
reverse clutch
flow to clutches
4th and reverse position

INSTRUCTOR'S GUIDE

Title of Unit: MICHIGAN/CLARK TRANSMISSION -- CONVERTER/TRANSMISSION

AM 2-22
9/22/67

OBJECTIVES:

1. To present a more detailed description of the working parts of the transmission and converter.
2. To show the student what happens within the transmission when shift changes are made.

LEARNING AIDS (suggested)

Vu Cells:

AM 2-22 (1)	Converter Power Flow
AM 2-22 (2)	Transmission Control Internal Oil Flow
AM 2-22 (3)	Transmission Cutaway
AM 2-22 (4)	Internal Tubing Diagram
AM 2-22 (5)	Manual Shift Spools and Oil Flow
AM 2-22 (6)	Clutch Oil Ports
AM 2-22 (7)	Neutral Position
AM 2-22 (8)	1st and Lo Forward Position
AM 2-22 (9)	2nd and Lo Forward Position
AM 2-22 (10)	3rd and Lo Forward Position
AM 2-22 (11)	4th and Lo Forward Position
AM 2-22 (12)	4th and Reverse Position

Models:

Arrangements can be made to have a working model of a Michigan/Clark transmission at your center. Teardown and Assembly on a class participation basis would be excellent for teaching purposes during these discussions.

QUESTIONS DESIGNED FOR CLASS PARTICIPATION:

1. What are the four parts of the torque converter?
2. What purpose does the drive disc serve to the converter?
3. What two members of the converter form the outer shell?
4. What two items create pressure in the system? Where are they located?
5. How much pressure is maintained on the clutches? What component causes this pressure? Where can this pressure be checked?

6. How much pressure is maintained in the converter?
7. Is the length of time critical in relation to maintaining converter stall? What can happen if this condition is prolonged?
8. Why is it important to mount the converter by hand instead of drawing it down with bolts?
9. How is the transmission theoretically divided into two parts or sections?
10. What two adjustments need to be made when the transmission is being reassembled?
11. What two purposes does the internal tubing serve inside the transmission?